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Europe Report

SCIENCE AND TECHNOLOGY

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25 SEPTEMBER 1986

EUROPE REPORT

SCIENCE AND TECHNOLOGY

WEST EUROPE

EAST EUROPE

COMPUTERS

MICROELECTRONICS

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WEST EUROPE/ADVANCED MATERIALS

PIRELLI ENTERS MARKET FOR SUBMARINE OPTICAL CABLES

Milan FATTI E NOTIZIE in Italian 4 May 86 p 7

[Text] Pirelli is rejoining the submarine telecommunications cable field. It is doing it in grand style, with optical fibers, the latest in technology for long distance transmissions of all kinds of luminous signals. "In the early 60s our firm made the decision to abandon submarine telecommunication cables while continuing a similar operation in the energy field," explains Antonio Laviano, sales manager of the telecommunications group. "The decision was made largely because of the introduction of satellites and the scarcity of expected investments by the Postal ministry for carrier cable. Now, the situation has changed and a 'comeback'' has become indispensable."

There are two changes to which Laviano referred. First of all, a decision was made, on an international level, that 50 percent of world communications would be carried by cable, entrusting the other 50 percent to satellites. In addition to the need for redundance, that is, to have available a communications network with a greater capacity than necessary in order to handle any eventual breakdowns or sudden system overloads without entrusting all traffic to a single technical carrier, there is also the matter of satellites affording less privacy in communications; they are far more delicate than cables and much more vulnerable. Hence, the new international orientation.

But, behind Pirelli's return to cables, there is also the great development in optical fibers as new carriers for signal transmissions. It is a revolutionary technology in which all large firms in that field will begin on a par to conquer world markets; that is, as though the advantage acquired by Pirelli's competition, while the latter was out of the submarine telecommunications field, had been suddenly wiped clean. Therefore, it would be wise to take a closer look at these optical fibers, fine as hair, but full of potential.

The old coaxial cables, approximately 50 mm in diameter, are capable of carrying something like 4,000 telephone circuits; however, the signals have a tendency of losing their strength after a short distance making it necessary to insert boosters in the circuit every 4 or 5 kilometers. In a six-optical fiber cable the diameter is reduced to about 25 mm, but the number of circuits is increased to 12,000 (for the time being because more are expected in the future) and the signals remain strong longer so that the distance between boosters can be increased to 50 kms.

"This, however, is not the only gain," adds Antonio Malesani, head of Pirelli's underwater optical cable project. "The optical fibers transmit digital signals, that is, codified in distinct numerical sequences. This takes place despite the addition of an integrated network between the data communications, the telephone call and picture transmissions." Which means that in the near future the data banks and the video telephones will operate over the same lines. How soon?

For all practical purposes Pirelli has completed the experimental phase of its program with the "sea trial" project, that is, the sea trials of the cable at the end of 1985. The laying of the 13 kilometer-long section between Messina and Reggio Calabria is scheduled for August-September of this year; the connection between Pomezia and Golfo Aranci (hence, between Lazio and Sardinia) is projected for May 1987; in 1988 the cable between Golfo Aranci and Palermo will be laid and, in 1989, Genoa and Golfo Aranci will be connected. This is not negligible if one takes into account that the first experiments go back to the late 70s with the laying of experimental land cables in Rome, followed in 1980 by the delivery of operative land cables to SIP and the National Telephone State Board. The decision to join the submarine cable field was only made in 1983 and the final "sea trial" was held in late 1985, that is, after merely 2 years.

"With 'sea trial,'" states Malesani, who took part in the experiment, "we simulated at sea everything that could occur to the cable during its operational lifespan. For 20 days off the coast of Siracusa, under sea conditions of up to state 4 (without, however, ever going below state 2), the cable was laid along the bottom and then cut, the two sections were recovered and spliced and then relaid. In a word, everything that needed to be done was done in order to prove whether the cable design under actual conditions of use met the standards set by its designers. The ship used was the 'Arabella,' a container ship equipped as though it were a regular cable-laying ship; all cable performance and all modifications that it underwent as a result of the laying and repair operations were checked by computer. The result: everything O.K. The stretching of the fibers under tension remained within normal limits; there was no significant alteration in the signal; the response to mechanical stress was good."

"The importance of these tests," Malesani adds, "cannot be underestimated; the system must have a very high degree of reliability. All components, the transmitting station, the overland section of the cable, the underwater section, the other overland section and the receiving station, not to mention the boosters, are guaranteed for 25 years. One cannot improvise." On the other hand, the underwater cable is not exposed to many hazards. Up to a depth of 800 meters there is the danger posed by trawler nets, but in deeper waters the only risks are from underwater earthquakes and landslides, phenomena that are not very frequent in the Mediterranean.

The only real care that must be taken is to determine during the laying of the cable that the sea bottom does not have any sharp rocks or very steep trenches capable of subjecting the cable to excessive tension. However, modern sonar prevents such surprises. In addition, the cable is protected: around the core of optical fibers there is an aluminum sheath, two steel straps, one of copper and over everything, a layer of polythene. The boosters are also well protected. A system is under study, however, to increase the space between boosters to more than 100 kms., precisely to avoid any possible malfunctions: what is not there cannot break down. Soon, therefore, the Mediterranean will be crisscrossed by an

optical fiber cable network, also because, as opposed to coaxial cables, branch lines can be spliced into the main trunks. This has actually been planned for TAT 8, the large transatlantic cable that will be completed in 1988 by the American AT&T, the British Standard Telephones and the French SUBMARCOM companies. Starting at Tuckerton, on the eastern coast of the United States, the cable will then branch off in the Bay of Biscay to reach Widemouth in Great Britain and Penmarch in France. In other words, optical fibers even beneath the oceans.

And what about Pirelli? Will its plants (Arco Felice for the cables and Fos for the fibers) continue to manufacture cables only for the Mediterranean? "For the time being our ambitions are confined to our own backyard," says Antonio Laviano. "However, tomorrow, who knows? Anything can happen!"

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WEST EUROPE/AEROSPACE

PROGRESS OF 'GIOTTO' SPACECRAFT

Rome AVIAZIONE in Italian Apr 86 pp 154-155

[Article by Cristiano Batalli Cosmovici, Institute of Nuclear Physics of Interplanetry Space under the National Research Council: "Giotto, a Miracle of European Space Science"]

[Text] At 0110 hours on the morning of 14 March 1986, European space probe Giotto succeeded in travelling through the gas and dust inferno of the tail and in passing only 600 kilometers from the nucleus of Halley's comet without being destroyed. According to data provided by the ESA (European Space Agency), the probe functioned perfectly until about 2 seconds before reaching the fly-by point, when collision with the dust at a relative velocity of 240,000 kilometers per hour caused change in the axis of rotation of the probe and accordingly of the transmitting antenna. This change, highly critical from the viewpoint of reception of radio signals on Earth, led to decrease in the intensity of telemetric data transmission. Intermittent reception of scientific data from the 4 surviving experiments continued, showing that the probe was proceeding on its regular course through the tail of the comet. The automatic antenna repositioning system operated flawlessly, the Carnarvon and Parkes active and passive stations in Australia resuming normal contact with Giotto 34 minutes after the interruption and continuing to receive data from the 4 surviving experiments.

At 0356 hours (universal time) on 15 March, about 24 hours after fly-by, the experiments were finally completed, and the next day a positioning maneuver was carried out to make certain that Giotto's antenna would continue to point toward Earth. The aim was to impart to the probe the acceleration necessary for it to pass in the vicinity of Earth in July 1990, and possibly to recapture the probe and bring it back to Earth in the Shuttle.

The most fantastic space adventure ever undertaken by Europe thus had an acclaimed happy ending on television screens throughout the world. No one dreamed this happy ending would come about after the sad end of the Soviet Vega 1 and 2 probes, which were filled with holes after coming within 35,000 kilometers of the nucleus of the comet, that Giotto would cross the fatal 10,000-kilometer threshold, and that it would pass, eroded but undamaged, only 600 kilometers from the core, missing its target by a mere 50 kilometers. It hit an object a few kilometers in diameter situated a distance

of 130 million kilometers from Earth, after travelling 247 days and covering 700 million kilometers.

The major problem for the Giotto mission was raised by the dust, which, moving at a relative velocity of 68 kilometers per second, represented a lethal hazard for the probe. It is enough to note that at this speed a grain weighing 0.1 gram can pierce a steel plate 10 centimeters thick and that Giotto's 2 protective shields were barely 2 and 23 millimeters thick. The multiple-color telecamera (HMC), the most important instrument on the mission, was entirely unshielded and faced the core of the comet squarely. Only a deflector mirror positioned at an angle of 45 degrees to the incident light served to absorb the dust particles, preventing them from striking the highly sensitive CCD sensors and accompanying electronic equipment.

The telecamera, the most complex one ever to fly in space, managed to record images up to 1,350 kilometers from the nucleus, with a steric resolution of 50 meters. At 4 hours and 19 minutes from fly-by (point of closest approach to the nucleus), it had come within about 1 million kilometers of the nucleus, and, after searching for and homing on the nucleus, began transmitting images 3 hours and 8 minutes from fly-by at a distance of 767,000 kilometers. About 2,000 pictures of the tail were obtained using all 11 filters and and with different aperture settings. Pictures of the nucleus proper were obtained starting about 5 minutes from fly-by, when the angle between the spin axis and the direction of the comet was 1.6 degree. The distance was 20,000 kilometers; 69 images of the nucleus were obtained simultaneously in 3 colors before the dust damaged the telecamera and the probe. The pictures showed a fanshaped tail of dust highly polarized in the direction of the Sun. The shaded area of the nucleus is about 15 kilometers wide. The nucleus is 4 to 8 kilometers wide and is covered at different points by streams of dust coming from the direction of the Sun. There are highly active zones, along with other inactive ones, on the surface of the nucleus. Contrary to what had been expected, the nucleus appears dark; this is due to the dust covering its icy surface. In addition, the nucleus rotates with a period of 52 hours about its major axis and seems to be covered with craters due to collision with meteors.

A detailed analysis of the pictures is still in progress. It involves fairly complex processing, especially to arrive at the true colors through the false colors supplied by the telemetry. During Giotto's crucial days, the author was in South Africa, at the Sutherland astronomical observatory, 400 kilometers north of Capetown, at an altitude of 1,800 meters on a plateau in the middle of the Karoo steppe. As a member of the Giotto telecamera (HMC) scientific committee, I had the mission of coordinating the simultaneous observations on Earth in Chile, the Canary Islands, and Australia and of personally conducting the observations in South Africa, the only country outfitted with modern telescopes capable of observing Halley's Comet at the time of Giotto's rendezvous. The same type of detectors, CCD (charged coupled devices), with the same 11 filters as aboard the space probe, was used on 3 continents. The purpose was to observe the behavior of the comet before, during, and after Giotto's fly-by, scanning an area 100,000 kilometers in diameter around the nucleus with a steric resolution of 500 kilometers (steric resolution provides the smallest detail discernible with an optical instrument, in the case of Giotto 50 meters at a distance of 1,350 kilometers from the nucleus).

The comet was impressive 24 hours before Giotto's rendezvous. It stood out clearly against the dark southern sky, its 30-million-kilometer tail highly visible to the unaided eye, despite the brightness of the Milky Way lighting the course.

The images obtained by telescope of the area around the nucleus showed very intense activity, with about 200 tons of gas and dust emitted every second from the active regions of the nucleus. I immediately thought of the fate in store for Giotto had this activity continued on the following day, but the queen of comets had been kind to the tiny, daring gnat coming from distant planet Earth to enquire into the comet's birth, nature, composition, form, and color. On the day of the fly-by we noticed a 300-percent drop in the activity of the gas and dust. This was the salvation of our probe. On the previous day, it would not have come even within 10,000 kilometers of the nucleus.

Aside from luck, credit must be given to European science and technology for having performed a veritable miracle in planning, developing, and successfully carrying out the first European interplanetary mission, and in addition the most complex mission ever accomplished on our planet. All this was done with the modest amount of 250 billion lire (American and Soviet interplanetary space missions each cost 1500 billion on the average).

The multicolor camera, in the development of which Italy participated, in the person of the author and the late Prof Giuseppe Colombo, Cesare Barbieri of Padua Observatory, and Marcello Corradini of the Institute of Space Astrophysics under the National Research Council, is a veritable gem of technology. For the first time a telecamera was mounted on a probe rotating on its own axis, was equipped with a CCD sensing system (with the most sensitive semiconductor sensors in existence), and was subjected to the dust storm of the most active of the periodic comets known to us. The deflecting mirror and the light shield of the telecamera were developed by the Galileo factory, under the direction of Padua University.

Other Italian institutions involved in 3 other experiments aboard the Giotto are the Institute of Interplanetary Space Physics under the National Research Council at Frascati in the JPA Plasma Experiment, Rome University 2 in the magnetometer experiment, and Bari and Lecce Universities in the disdy dust experiment.

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WEST EUROPE/AEROSPACE

FRENCH ASTRONAUTS CHOSEN FOR JOINT SOVIET MISSION ON 'MIR'

Paris L'HUMANITE in French 1 Aug 86 p 11

[Article by Jean-Pierre Defait]

[Text] Jean-Loup Chretien is signing up again. The first French astronaut to visit space, who spent a week on board the Salyut 7 in June-July 1982, will return to the City of Stars in the autumn. The National Space Studies Center officially announced yesterday that he has been chosen, along with a lieutenant colonel in the Air Force, Michel Tognini, 35, to make the next Franco-Soviet flight. The exact date has not as yet been set, but the flight may take place in July of 1988.

The choice of Jean-Loup Chretien, who is now 47, was not exactly a surprise, since last March he had already completed an important stage in the veritable obstacle course involved in preparing for space flight. He was selected at that time, along with Michel Tognini and a CNES engineer, Jean-Luc Clairvoy. The three men recently underwent medical examinations in Moscow, and thus it will be the civilian, Jean-Luc Clairvoy who will pay the price of this last test. Jean-Loup Chretien, who is currently on vacation, is "delighted" that he was chosen. Particularly since the CNES made him the number one man, thus making Michel Tognini his "stand-in," the less glorious role played by Patrick Baudry before him. With the difference, however, that the second French astronaut knew for a certainty at that time that he would eventually make a flight on the American shuttle, a dream which Michel Tognini can hardly hope to see realized.

The CNES, which could have opted, for the second Franco-Soviet flight, to train a new cosmonaut in space exploration, thus chose to rely on the experience of Jean-Loup Chretien instead. It is of course up to the Soviets to choose between the two men, in the final analysis, following training and a just a few hours before launching. The law of selection is cruel. But whatever the case, whichever man makes the flight in 1988 will gain extraordinary experience. It will not be until next October in Erivan, Soviet Armenia, that the French and the Soviets will establish the final schedule for this joint mission. But it is already known that the flight will be made on board the MIR, the new Soviet station, and it will be a lengthy one of 3, 4 or even 6 weeks. And then, a premier performance. It is probable that the French cosmonaut will venture out into space, perhaps to work on the

construction of a metal frame on the outside of MIR. In the meantime, the French are making active preparations for this flight, which was definitively agreed upon in principle in 1985 at the time of the meeting between Mikhail Gorbachev and Francois Mitterrand in Paris. The French are expected to contribute 12 medical and technological experiments currently under study to the common basket.

For their part, Jean-Loup Chretien and Michel Tognini, who have already been studying Russian for several months, are preparing for long months of training, lasting nearly 2 years, very briefly interrupted by the 1987 summer vacation. And the Soviets have announced the suit. The length of the flight and the obligatory walk in space will be difficult. What is certain is that the experience gained by Jean-Loup Chretien and Michel Tognini will make a precious contribution to the Hermes program. All that remains is to wish them both good luck, now and in the future.

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WEST EUROPE/AUTOMOBILE INDUSTRY

FRANCE'S PEUGEOT RECOVERING ITS POSITION

Paris L'USINE NOUVELLE in French 12 Jun 86 pp 47-49

[Article by Georges Le Gall]

[Text] With a net profit of 543 million francs in 1985 (0.5 percent of the turnover figure of 100 billion), the Peugeot group is finally out of the red. After accumulating 8.6 billion in losses over 5 consecutive years, between 1980 and 1984, Jacques Calvet has thus won his bet. But he fell short of his prediction, since the return to balance was planned for 1983, and then 1984.

Thus it is understandable that the president of PSA assesses the 1985 results as modest. "This is still not enough. It is but one stage in the recovery, which must be speeded up." Jacques Calvet has set his sights high, with a net profit equal to 4 or 5 percent of the turnover figure as his goal. He admits it. "This is tremendous in comparison to usual French practice."

This is however the performance level of the leaders in the world automobile industry--General Motors, Ford and Toyota. And also the other European enterprises of a size comparable to that of PSA. Last year, the net profit of Fiat was 6 billion francs, with a turnover total of 125 billion. It is true that the net profit of Peugeot was 4 percent in 1976. This set a record, as the average for the years between 1970 and 1979 fell between 2 and 3 percent.

Chrysler waited for the day PSA announced its return to the ranks of the profitable firms to put on sale stocks representing 12.5 percent of the PSA capital (a quarter will be sold in France, and three quarters abroad). These stocks were purchased in 1978 when Peugeot took over control of the European subsidiaries of this American manufacturer. This coordination bears witness to the good relations between the two companies. After taking over control of Citroen in 1976, Peugeot soughtto strengthen its international dimensions in this way. But the takeover of Simca (which had become Talbot, and then merged with Peugeot in 1980) proved a failure, which had its effect on the financial results achieved by PSA and the rate at which it renewed its range of products. From 43 percent in 1979, the PSA share of the French passenger-car market fell to 30.2 percent in 1982. Despite personnel cuts, the break-even point in 1984 was still 1.7 million vehicles, in other words more than the actual production of 1.6 million.

It was at the end of 1982 that the first new PSA models, the Citroen BX and the Peugeot 205 came out. They represented almost half of the total production of the group last year. It was then that market recovery began. Today the hardest part has been accomplished. The return to the profit sector is not explained by any recent miracle, but rather represents the results obtained in sales and marketing, production and management. In 1985, the total sales of the group came to 1,661,000 vehicles (up 5.1 percent over 1984), including 759,000 in France (up 8 percent) and 902,000 sold abroad (up 2.7 percent). But the production total of 1,631,000 vehicles was up only 1.9 percent, since stocks declined, thanks to better coordination between the factories and the suppliers and the commercial network.

Personnel was reduced again, to 177,000 individuals (down 6 percent). Industrial retooling led to the closing of the Clichy and Nanterre plants. The rigorous job and wage policy did not prevent an effort to improve skills, involving 2.5 million training hours (up 10 percent).

While it had increased steadily in the course of the preceding fiscal years, net indebtedness was reduced from 33.1 to 32.4 billion. Thus physical investments increased greatly, reaching 5.9 billion (up 46 percent), with plant modernization to allow for the new models.

The group had 571 category C and D robots at the end of 1985, as compared to 317 a year earlier. It will have 723 by the end of 1986. Productivity per person employed increased by 8.5 percent and quality improved. At Citroen, finishing costs were 3.5 percent less for 8.3 percent more vehicles.

In all, the break-even point finally fell slightly below real production. And sale prices rose a little more rapidly than cost prices, such that profits reappeared.

Despite the unknown aspects of the extent of the recovery on the French market, Jacques Calvet is optimistic about 1986. In Europe outside of France, PSA is making progress, with an increase of 9.1 percent of the car registrations in the first 4 months and a total market up 7.5 percent. Citroen is likely to come back into balance. The net profit of PSA will increase significantly.

The need for strict control remains, however. Personnel will be reduced by about 6 percent again. On the other hand, investments will exceed 2 billion francs, increasing to about 8 billion in 1987 and 1988 in order to provide for the replacement of models, particularly in the upper range. This will make a serious campaign for new markets, including the United States, where Peugeot occupies a mediocre position and Citroen is not active at all, possible.

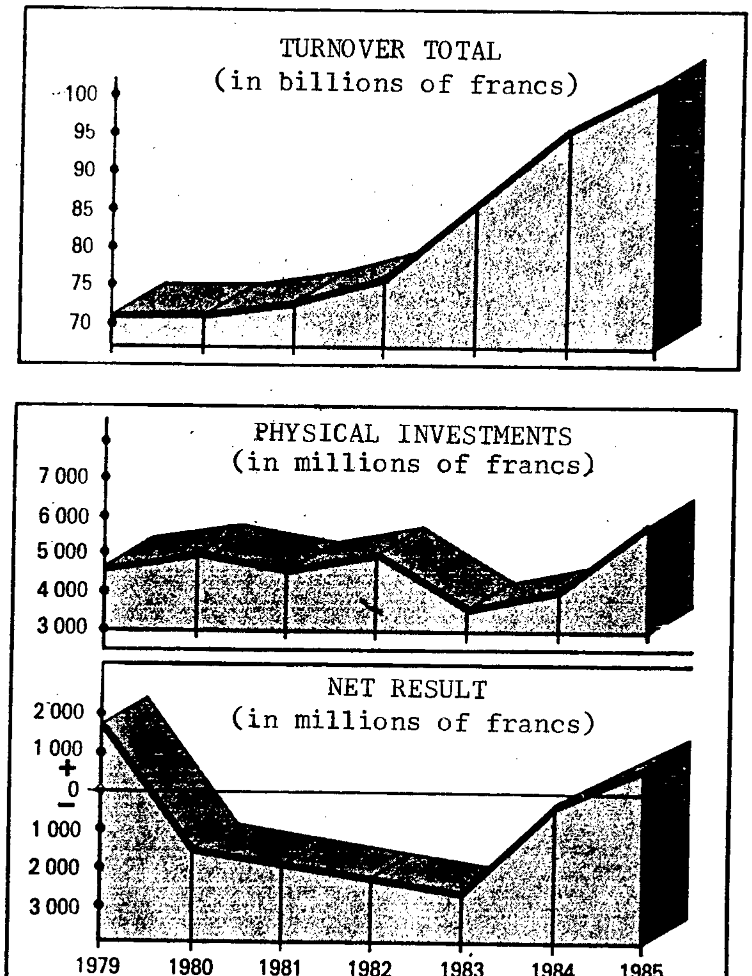
Increased Production Capacity

Jacques Calvet is obviously targeting profitability more than volume. The break-even point will be reduced to 1.4 million vehicles in 1986, and 1.2 in 1987. But production capacity will simultaneously be increased from 1.8 to 2 million. If PSA succeeds in selling almost 2 million vehicles, the goal of a net profit of between 4 and 5 percent will be within reach.

PSA is on the way to recovery. Renault is very far from it, and is surviving on transfusions. To see the two French manufacturers making a profit simultaneously, one must go back to 1979.

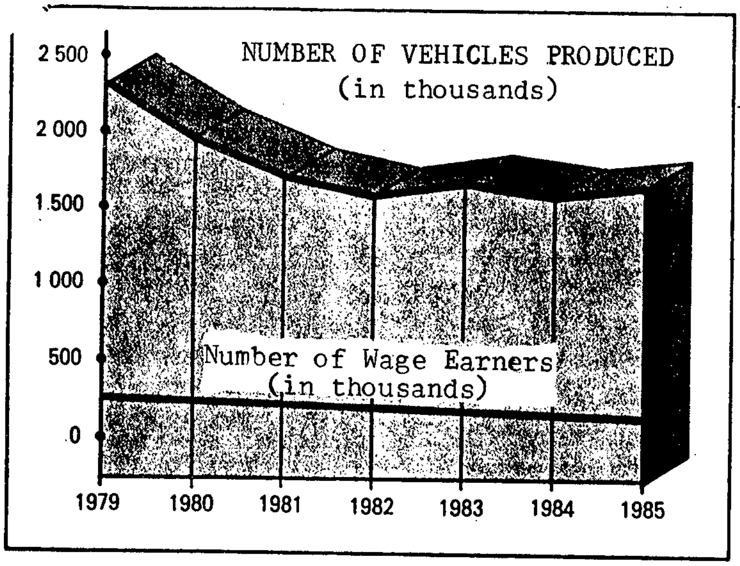
Five Years in the Red

In 5 deficit fiscal years, from 1980 to 1984, PSA accumulated losses totaling 8.6 billion francs.



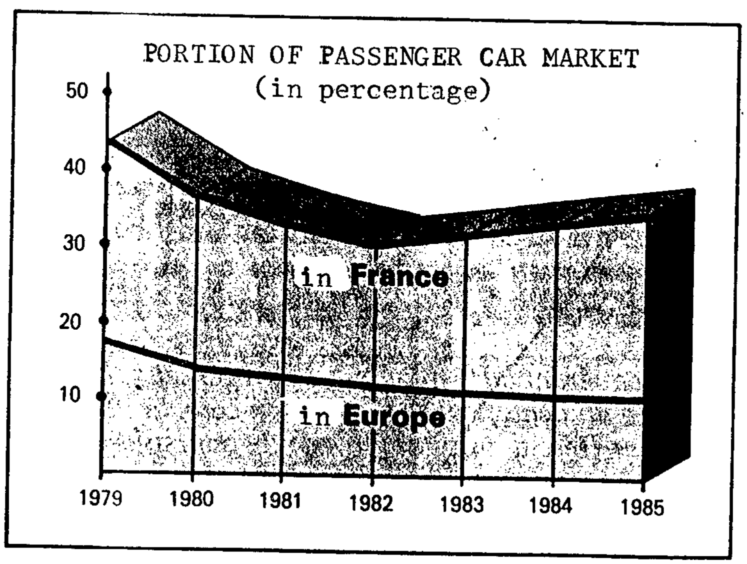
Source: Annual PSA reports.

Productivity Increase of 8 Percent in 1985



Between 1979 and 1984, the reduction in personnel and the decline in production were parallel (down 30 percent). In 1985, on the other hand, the number of vehicles produced was up 2 percent, with wages down 6 percent.

Recovery on the French Market Since 1983



After the low point in 1982, PSA regained ground on the French market, but because of the slump, this did not suffice to ensure recovery in Europe as a whole.

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WEST EUROPE/BIOTECHNOLOGY

NEW FRENCH RESEARCH MINISTER ON PLANS FOR BIOTECH

Paris BIOFUTUR in French Jun 86 pp 7-9

[Interview with Alain Devaquet, French Minister of Research; interviewer, date, and place not given]

[Text] Alain Devaquet, deputy minister for research and higher education in the Ministry of National Education, consented to be interviewed by BIOFUTUR. Here he reviews public and private efforts in the biotechnology field and offers his comments on what his policies are likely to be in this area.

A man of political convictions (he is a member of the central committee of the RPR) and mayor of the 11th arrondissement of Paris, the new research minister is a scientist first and foremost. A graduate of the Ecole Normale Superieure of Saint-Cloud, he holds a doctor of science degree in physical science. After a stint as research director at the CNRS, he became a professor in the faculty of sciences at [the University of] Paris and the Ecole Polytechnique. His training as a research physicist does not prevent him from being open to other scientific fields and very attentive to the necessity of keeping scientific information flowing from the laboratories to the general public. "Humanizing science is one of the essential missions of the scientist," he insists. For him, effective popularization, while difficult, is both possible and indispensable. It responds to a public need. Furthermore, in the biological area, which is rich with elements deeply rooted in the collective unconscious, a gulf must not be allowed to form between scientists, basic or applied, and the general public, which discovers applications of the work of those scientists. "One of the essential characteristics of biotechnology is the extraordinary speed with which things move from theory into practice," the minister told us. He also emphasized that the transfer process, which is crucial to the development of biotechnology, has been made possible only by the construction of bridges between basic and applied research: "People who still try to disconnect these two endeavors [basic research and applied research] are ignoring a number of disciplines, the most important of which is biotechnology." With Japan committing extensive resources to a set of biotechnology projects (see Mr Nakasone's comments at the recent Tokyo summit), France must fight to retain its place among the leaders. To do so, the country must continue the efforts launched with some success, in the minister's view, under Programme Mobilisateur (BIOFUTUR, January 1986). Above all, Mr Devaquet intends to remain a pragmatist. In this spirit, he will gradually take on the details of budgetary allocations. This is likely to be a difficult process given the severe reductions in the research budget.

[Question] [BIOFUTUR] Do you share BIOFUTUR's view that biotechnology is a priority for France and for Europe?

[Answer] The term biotechnology covers a set of techniques, some of which are very old (although they may be empirical) and others very modern. Their considerable growth in recent years was made possible thanks to progress in genetic engineering, cellular biology, and information processing. Like any cutting-edge technology, the biotechnologies have a priority, given the considerable advances foreseeable in the fields of health, agriculture, and chemistry. It is quite obvious that Europe, and particularly France, must develop the know-how that will allow our country to have a presence in those future fields that reflect its humanitarian tradition (new vaccines, more powerful diagnostic instruments), its efficacy in the field of medications, and its agricultural potential.

[Question] Do you believe, as we do, that in biotechnology there are close links between basic and applied research?

[Answer] The relations between basic and applied research are difficult to define. But it is obvious, for example, that genetic engineering could not have existed in the absence of extremely basic research and that the delay between the discoveries and their application has been exceptionally short. On the other hand, the biotechnologies are leading technologies, they are very sophisticated, and they render immense service to numerous theoretical research programs, some of which will probably have very important practical applications in the near future. The links between basic and applied research should be improved through more effective cohesion between the various practical and theoretical aspects of biotechnology: biochemistry, cellular and molecular biology, biochemical engineering, industrial microbiology, extraction, and analysis.

[Question] In some fields such as microbiology and genetic engineering (in plants for example), there is wide agreement that "France is behind." projects have been developed in recent years to bridge that gap. Will you be able to support these, or even expand them?

[Answer] France is not as far behind as some bitter voices claim. Our country is in the group that trails the United States and Japan. If you take into account the size of the United States and of Europe, our performances are not far from being equivalent. Nevertheless, our country must make an effort to stay within this group, primarily in two areas: microbiology and genetic engineering in plants. Also, I am proud to say that in the area of microbiology, the seed money provided by the Programme Mobilisateur [Mobilization Program] amounted to 40 million francs from 1983 to 1985 and 50 million francs for 1986 (within the framework of "Food 2000"). The efforts centered on:

a) Lactic fermentation. This topic covers absolutely all areas of the food industry. Efforts join together industry professionals and researchers. The overall amount over the period 1983-1985 was 15.7 million francs.

b) Fermentations for the health industry. The production of steroids, antibiotics, and vaccines ammounted to 11.5 million francs.

c) Aid for the development of a microbiological transfer center in Toulouse.

d) Support for institutional research: program contracts with the INRA, the CNRS, the Pasteur Institute, the Ministry of National Education, regional activities, 20 million francs.

e) Grants for training and respecialization: 25 grants.

With regard to genetic engineering in plants, the seed money provided by our program was 37 million francs for the years 1983-1985; this will of course be continued. It covers not only genetic engineering in plants, but also all of the biotechnologies that contribute to the improvement, creation, or protection of plant species:

--improvement of in vitro growth of plant species: grapes, ornamental varieties, legumes, etc.: 15 million francs;

--genetic marking in corn: 5 million francs;

--training and respecialization grants: 26 million francs;

--program contracts with the INRA: 4.6 million francs (INRA is giving this issue new priority).

[Question] In Japan, the MITI is committing a billion francs over 5 years to "protein design." How can France and Europe rise to this challenge?

[Answer] It is not necessary for us to follow a certain model or to "prostrate" ourselves before the MITI. Japan's needs are very specific, particularly in the synthesis of proteins, which should solve a number of [their] food problems. I would not say that we were facing a challenge, but we must plan for the changes that will be required in our own food industries in view of new forms of production made possible by biotechnology.

In any event, France and Japan have already begun a bilateral program centered on exchange of researchers.

[Question] French professional circles congratulated themselves on the implementation, in the summer of 1985, of the Mobilization Program in biotechnology and on the policy initiated by the program's directors. Will the efforts of the government in this area be continued?

[Answer] The spectacular development of the scientific disciplines underlying the biotechnologies has made possible a qualitative leap in the bioindustries:

--through the improvement of existing products and processes;

--through the creation of technological tools and new products.

The major economic consequences that can be expected are:

--the fertilization of traditional manufacturing sectors with sales in the billions of francs, e.g., the food industry (450×10^9 francs), health (50×10^9 francs), perfumes, etc.;

--the development of new and rapidly expanding markets;

--the improvement of existing markets through reductions in production costs and increases in quality.

The example provided by the production of industrially useful molecules is telling: traditional methods have frequently been clumsy and costly (pharmaceutical screening, chemical synthesis, extractions, etc.). Genetic engineering and microbiology are enabling us to transfer and multiply vital functions in all areas.

As a result, the progress stimulated by cutting-edge techniques will not be spontaneous in the traditional sectors. The primary role of the Mobilization Program is to build interfaces that encourage transfers and contribute to the elimination of sticking points.

I do not have to add that I am completely convinced that the efforts of this program could be intensified.

[Question] Are you in favor of including industrial biotechnology projects in the Eureka program?

[Answer] I am by definition in favor of any solid and coherent European program. Our basic and industrial research must be set in their natural context, which is Europe.

With respect to biotechnology programs being included in Eureka, the projects have taken a relatively long time to be developed, given the complexity of the operations needed to set up and develop cutting-edge technologies in rather traditional sectors.

Five projects have now been presented and are likely to begin in 1986 or 1987.

1. Resistance of the sunflower to drought (Rhone-Poulenc). This project, presented by Rhone-Poulenc, deals with seed strains.
Project cost: 27 million francs over 7 years
Government share: 10 percent (50 percent manufacturer)
No use of public funds in 1986

2. Diagnostics in blood transfusion (Clonatec)
Cost: 113.5 million francs over 5 years
Government share: 44 percent
Industrial financing: 30 percent

3. Antimalarial vaccine (Pasteur Vaccins)
Cost: 90 million francs over 3 years
Government share: 66 percent
Industrial financing: 50 percent

4. Animal cell cultures (Bertin-Institut Pasteur)
Cost: 150 million francs over 3 years
Government share: 45 percent
Industrial financing: 50 percent

5. Synthetic tomato seeds (Limagrain)
Cost: 20.2 million francs over 5 years
Government share: 66 percent
Industrial financing: 50 percent.

[Question] For 4 years, BIOFUTUR has been trying to disseminate scientific, technical, financial, and regulatory information useful to biotechnology professionals. We have recently begun an English-language bimonthly letter devoted to European biotechnology (EBN). What is your overall view of this initiative? Criticisms? Suggestions?

[Answer] Any means of improving either nature herself or the speed with which information is passed between researchers and industry seems to me to be of the utmost necessity.

The use of English will enable you to facilitate exchanges between various European partners, and I can only congratulate you on your project.

13221/12859
CSO: 3698/611

WEST EUROPE/BIOTECHNOLOGY

BRIEFS

BIOSENSOR FIRMS IN FRANCE--Biosensors occupy a small but very promising niche, in the view of Jean-Louis Romette of the enzyme engineering laboratory at the University of Compiegne (UTC). "Witness the success of the American company, Yellow Stone: 800 units sold in 3 years on the U.S. market, and these are not even of the highest quality." A biosensor is the linking of a biocatalyst, usually an enzyme, with an electronic interface. According to Romette, "We'll have to wait a few years before we see mass distribution of these techniques." In France, three firms have already moved into commercialization: Setric in Toulouse, Solea Tacussel in Lyon, and Seres in Aix-en-Provence. "The introduction onto the market of the first generation of biosensors will raise the level of production processes, which up to now have been best mastered by those manufacturers possessing their own analytical know-how. These firms will now be led to commercialize their techniques." [By Patric Genvrin] [Excerpts] [Paris INDUSTRIES & TECHNIQUES in French 20 Jun 86 p 29] 13221/ 12859

CSO: 3698/611

WEST EUROPE/LASERS, SENSORS, AND FIBER OPTICS

BRITISH FIBER OPTIC MEASURING DISCOVERY

Paris L'USINE NOUVELLE in French 24 Apr 86 p 88

[Unsigned article: "Fiber Optic Temperature Distribution Sensor"]

[Text] The possibility of performing a distributed measurement of temperature at several points is a recent discovery in fiber optics.

Earlier methods used liquid-core fibers whose lifetime is not well known, and while solid-core fibers are more reliable, they are also less sensitive. This drawback has been circumvented by researchers at York University in England, by detecting only the Raman component of the light beam dispersed in the fiber. Although the light intensity of this component is three times weaker than that of the total signal, its temperature sensitivity is sufficient to obtain an efficient instrument. The development sensor has an accuracy of 1 °K over a kilometer of fiber, with a resolution of 7.5 m.

The experimental device uses a pulsed beam laser source with a power of 350 mV. The Raman component reflected in the fiber is separated from the others with a special filter, then detected with a photodiode followed by a preamplifier. The multiplied signal is then processed by an eight-bit analog/digital converter and averaged 100,000 times in a multichannel digital computer. The most efficient fiber for this type of distributed measurement is a multimode fiber with a numeric opening of 0.3 and a core diameter of 100μ.

11,023
CSO: 3698/618

WEST EUROPE/METALLURGICAL INDUSTRIES

ITALIAN RESEARCH IN CONTINUOUS CAST STEEL

'Fast' Process

Rome BOLLETTINO TECNICO FINSIDER in Italian Sep 85 pp 51-57

[Article by A. Spaccarotella]

[Text]

INTRODUCTION

In recent years, the CSM, in cooperation with Terni Steelworks, has developed a new technique known as «Forced Acceleration of Solidification Technology» (FAST) for application to continuous casting machines, so as to increase plant productivity and improve the internal quality of the product.

The new technique involves the feeding of metal powders of appropriate analysis and grain size to the molten steel, when it is being cast from the tundish into the mould. At the present time it is in use on Terni Steelworks 180-t, 8-strands continuous casting machine producing 140 x 140 mm billets for the manufacture of products with low reduction ratio and no internal defects.

On the basis of CSM's patents [1, 2] and within the framework of research performed with financial aid from the ECSC, investigations have been made with a view to extending the FAST to the field of steel microalloying in the mould.

This report presents the results of laboratory and works tests carried out for evaluating the operating performance of this new process for superheat control and steel micro-alloying in the mould, both during open and submerged casting.

THE FAST PROCESS - PRINCIPLES AND PRESENT DEVELOPMENTS

The FAST theory for superheat control has been discussed in earlier publications [3-5]. The basic concept of this new technique consists in extracting all or part of the superheat of the steel in the mould by feeding in low melting point metal powders. This permits the formation of centres of heterogeneous nucleation in the molten metal and inhibits columnar growth during solidification.

In this regard the FAST plays the same role as the EMS (Electromagnetic Stirring) in controlling the segregation phenomena and solidification structure.

Taking into account that these aspects have already been reported [6-7], here attention will be paid on other important applications of this new technique, enabling the steel microalloying in the mould to be performed.

Among the microalloying elements, particular care was devoted to ones which are very sensitive to oxidation, like *Al*, *B*, *Ti*.

As far as *Al* is concerned, its addition in the mould with FAST, otherwise the existing methods [8-9], makes it possible to broaden the application field of the continuous casting machine for making billets of *Al*-killed steels (grain refined steel, forging steel, microalloyed steel, etc.).

In fact, this new method enables the problem of the tundish nozzle clogging, due to the deposition of alumina, to be overcome.

The interest of adding the other micro-elements in the final stage of the casting, just before the steel solidification, is dictated by achieving the maximum alloy yield.

As described in the following, practical solutions (of FAST application) have been found, depending upon the casting system used (open or submerged casting).

USE OF FAST AND STREAM PROTECTION IN OPEN CASTING

At the present, FAST application at Terni Works is designed to ensure billets of high internal quality, free from macrosegregation and axial porosity, in order to produce large-diameter (57 mm) round reinforcing bars for nuclear industry. The cooling material adopted is low melting point *Si-Mn* steel powder which is fed at a rate of 10 kg t^{-1} steel.

In view of broadening the productive mix of the c.c. plant to include *Al*-killed steels and boron steels of improved hardenability for automotive applications (crankshafts, axles, etc.), tests have been mainly carried out for ascertaining the system suitability for steel micro-alloying with *B*, *Al*, *Ti*, etc. in the mould.

For this purpose stream protection, to prevent secondary reoxidation of the steel and to ensure a high yield of the alloying materials, was considered as necessary.

Stream protection system

The system was designed for meeting the following requirements:

- simultaneous addition of powdered materials in the protected zone;
- easy access for emergency operations;
- no disturb of liquid steel flow.

CSM has developed two gas stream-protection systems, one with an annular tube, and the other named SPAG (Stream Protection with Argon Gas).

The annular tube had fifty-six 2.5 mm diameter nozzles and was to be located beneath the tundish for conveying an inert gas flow as a protective curtain around the stream of molten steel.

The SPAG device (fig. 1) consists of a refractory lined casing which encloses the space between the tundish and the mould and surrounds the perimeter of the mould. It is equipped with a lance for gas introduction.

A swivelling arm anchored to the tundish allows for the insertion of the device beneath the stream when the casting strand is being started up.

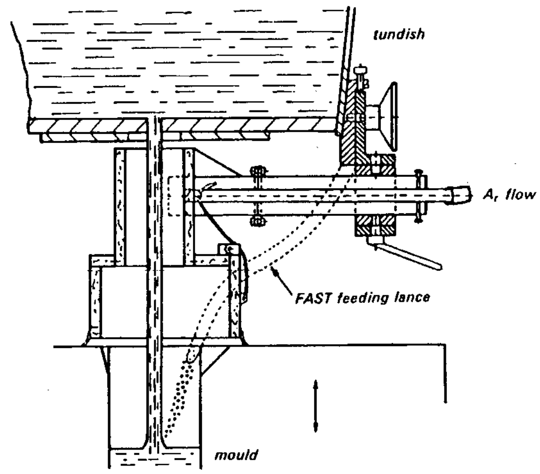

Fig. 1 - SPAG design for steel stream shrouding

The performance of the two protection systems was ascertained by measuring the partial pressure of the oxygen in the atmosphere around the stream, using an electrochemical probe before and during application of the protection system [10].

Works trials have been run using both systems on the Terni billets plant.

Figure 2 illustrates the relationship between the inert gas flow-rate and the oxygen potential in the zone around the stream.

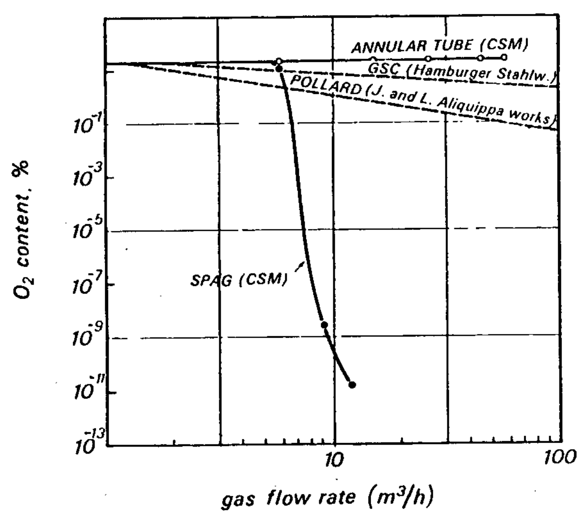

Fig. 2 - Effect of gas flow-rates on O_2 content for different stream shrouds

The annular tube system provides no protection for the stream even when very high gas flowrates are used (Q_{max} = 53 m^3h^{-1}). The SPAG system instead affords very good protection; with a gas flow-rate of Q = 9 m^3h^{-1}, an O_2 percentage of 2.4×10^{-9} is

achieved. A critical flow-rate of about 6 m^3h^{-1} appears which enables air leakage to be strongly reduced.

Taking due account of O_2 concentration (<1%) normally assumed for ensuring a satisfactory stream protection [11-12], SPAG system seems to create more favorable conditions in comparison with other similar systems industrially applied [11-13-14-15].

Also the economic aspects connected with gas consumption can not be neglected, when high stream protection is desired. With SPAG system, a specific gas flow-rate ($\simeq$ 0.5 m^3t^{-1}) is required, much lower than the reference value (>1.5 m^3t^{-1}) taken from the literature [13-14].

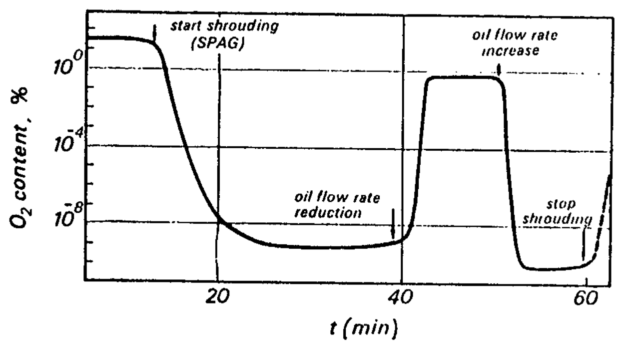

Fig. 3 - Influence of oil lubricating flow-rate on O_2 content around the stream with SPAG shroud

Figure 3 illustrates the typical trend of oxygen content versus time with the SPAG system. This highlights the effect of the lubricating oil flow-rate in the mould. It is evident that a 30% reduction in the nominal oil flow-rate ($\sim$ 40 cm^3min^{-1}) results in a rise in O_2 concentration from 2.4 x 10^{-9} to 0.6%.

Mould microalloying tests with FAST-SPAG System

A combined use of FAST and SPAG was carried out for steel microalloying. The configuration applied on one strand of Terni c.c. billets machine, is shown in figure 4.

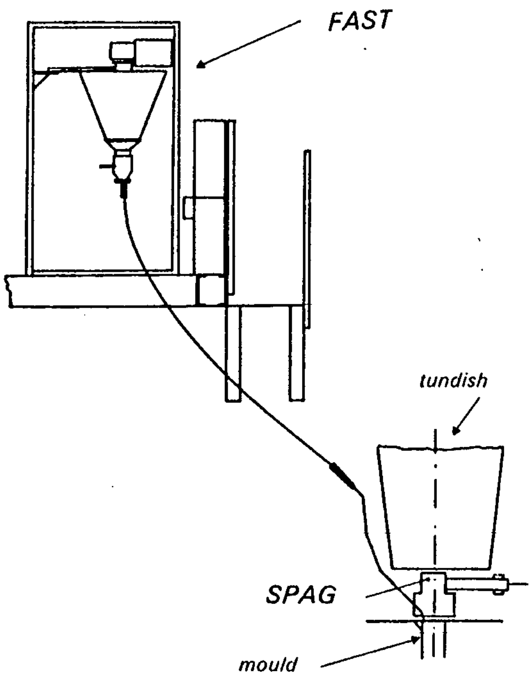

Fig. 4 - FAST - SPAG combined system for steel microalloying in billet continuous casting

Table 1 - *Metal powders characteristics*

alloy powders	composition %								particle shape	size range μm
	C	Si	Mn	S	P	Ti	Al	B		
steel	0,88	0,49	0,68	0.015	0.013	—	—	—	spherical	180-300
B pig iron	2.67	1.64	1.25	0.040	0.017	—	0.011	0.95	spherical	50-250
FeB	0.046	0.30	0.36	0.010	0.008	—	0.64	18.0	granular	100-500
FeAl	0.92	0.72	0.77	0.012	0.012	—	2.0	—	granular	200-1000
grainal	0.13	2.63	6.0	0.007	0.029	8.6	13.28	0.89	granular	500-1000

Table 1 sets forth the main physical and chemical characteristics of the metal powders containing *B*, *Al* and *Ti*.

With FAST, metal powders are fed by gravity directly into the mould: through a small window practiced in the SPAG casing, the lance allows for the addition of the powder on the steel meniscus.

Additions of B *and* Al *during unprotected open casting*

A preliminary set of trials was run to establish reference conditions for the system in the case of unprotected open casting.

Microalloying with *B* was performed using the following types of material:

1. Mix of *FeB* and steel powder (10/90 ratio)
2. Granular boron pig-iron
3. Grainal alloy.

Microalloying with *Al* was tried using *Fe-Al* powder as the alloying material.

Table 2 sets forth the main operating parameters of the tests.

Table 2 - B *and* Al *micro-alloying trials by FAST in open billets casting*

heat	alloy powder	C liquid steel	tundish temp.	casting speed	feeding time	feeding rate	powder percent	solute elements		
								type	theoric value	effect. value
n.	type	%	°C	m min⁻¹	min	kg min⁻¹	%	--	ppm	ppm
027	steel + FeB 90/10	0.40	1535	1.99	22.5	1.33	0.44	B	79	70
028	B pig iron	0.37	1540	1.93	20.5	1.76	0.60	B	57	44
063	FeAl	0.45	1550	2.02	20.0	1.04	0.34	Al	68	61
068	FeAl	0.43	1535	1.91	21.0	2.07	0.71	Al	143	130
315	steel + grainal 50/50	0.48	1535	1.87	9.0	0.81	0.28	B	13	11
								Al	189	160
								Ti	123	100

Table 3 - B *micro-alloying trials by FAST in protected billets casting*

heat	protection device	alloy powder	C steel	tundish temp.	casting speed	feeding time	powder flow-rate	powder percent	$B_{theoric}$	B_{eff}
n.	—	type	%	°C	m min⁻¹	min	kg min⁻¹	%	ppm	ppm
299	SPAG	B pig iron	0.45	1550	1.91	18.0	1.41	0.48	46	42
306	annular tube	steel + FeB 90/10	0.44	1550	1.83	28.5	0.88	0.32	57	50

The granular *B* pig-iron melts most rapidly because it is lower-melting than *Fe-B* and it dissolves more easily in the liquid phase. Chemical analyses run on cross-section and longitudinal samples from the billet do not reveal any marked difference in behaviour between the two materials.

Boron, expressed as B_{tot}, was determined by the glow discharge lamp method. The yield of the *FeB* was found to be higher than that of granular *B* pig-iron.

Addition of B *during protected open casting*

To evaluate the efficiency of protection against stream secondary reoxidation and hence the improved yield of the microalloying agents, tests were run using both CSM gas protection systems for adding *FeB* and granular *B* pig-iron.

Tests operating conditions are given in Table 3. Argon was the protective gas used.

Table 4 indicates the yields of the microalloying agents depending upon powder type and stream protection system adopted.

Table 4 - *Effect of stream shrouding on micro-alloying powders yields during FAST trials*

micro alloying powders	element	yields %		
		unprotect casting	shrouded casting	
		—	annular tube	SPAG
B pig iron	B	77.2	—	91.3
steel + FeB 90/10	B	88.6	87.7	-
steel + grainal (50-50)	B	84.6	--	100
	Al	84.7		86.[illegible]
	Ti	81.3		10[illegible]

It is evident that stream protection exerts positive action, yield values being higher in comparison with reference ones (unprotected casting).

It is noteworthy that the use of the SPAG device has markedly improved the yield of microalloying elements.

In particular with regard to *B* and *Ti*, values equal to 100% have been obtained as a consequence of highly protected atmosphere around the stream.

Metallurgical aspects

Surface and internal quality of billets was observed for assessing the improvement connected with, the new techniques.

Uniformity of distribution of the alloy elements was revealed as good on both the transverse and longitudinal sections of the billet. Figure 5 illustrates the patterns of *C* and *B* contents on the transverse section of the

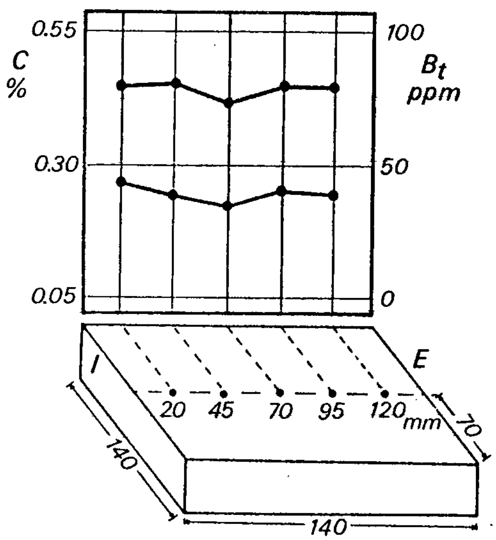

Fig. 5 - Patterns of *C* and B_{tot} contents on FAST billet cross-section cast with SPAG protected stream

billet with the use of FAST combined with SPAG system. It is evident that the distribution of *B* is uniform and that there are no localized concentrations of *C* induced by high carbon boron alloy.

The addition of *Al* to *Si-Mn* killed steels in the mould improves internal cleanliness of the billet and eliminates the band of macro-inclusions that otherwise accumulate near the upper side of the billet, especially in curved mould and small radius machine [16-17], as evidenced by sulphur prints of the transverse and longitudinal sections shown in figures 6 and 7.

Metallographic examination of the samples taken from billets produced with Grainal addition, reveal the beneficial effect on the type and morphology of inclusions (fig. 8). In particular, the FAST process ensures drastic reduction in the number and size of inclusions, while favouring the formation of mixed aluminates which separate more rapidly than manganese silicates, as confirmed by SEM analysis.

USE OF A MODIFIED FAST IN SUBMERGED CASTING

The phenomena which can be governed with FAST, namely superheat control and steel microalloying in the mould, are of even greater importance in the submerged c.c. of blooms or slabs for the manufacture of high surface and internal quality products [18-19].

For several years now the CSM has been working on the modification and adaptation of the FAST to submerged casting in order to overcome the many technological and metallurgical difficulties that are involved. As a result, a modified version has been devised for the introduction of solid material to the mould via the tundish stopper rod. This system enables the solid material to be fed into the stream of steel which passes through the tundish nozzle without requiring a flow of inert gas, since it exploits the Venturi effect created there by the abrupt restriction in the outflow section controlled by the stopper rod.

Theoretical fluid dynamics studies, pilot-scale experimentation have provided the basic knowledge to perfect the feeding system that has been developed for works trials [3].

A feed system based on the introduction of a cored wire into the mould through the hollow stopper rod of the tundish is being developed.

For a correct design of the wire introduction the following requirements have been taken into consideration:

- suitable ratio between the wire diameter and the hole size of stopper rod;
- assuring the complete melting of wire sheath and the solution of reagent elements in steel within the mould length;
- perfect alignment of the wire with the stopper rod axis;
- proportioning of the wire feeding rate with casting speed.

For meeting these requirements a machine has been accomplished that includes a reel-wound coil and a wire-guide device driven by a variable-speed hydraulic motor (fig. 9). It can be seen that the feeding unit is

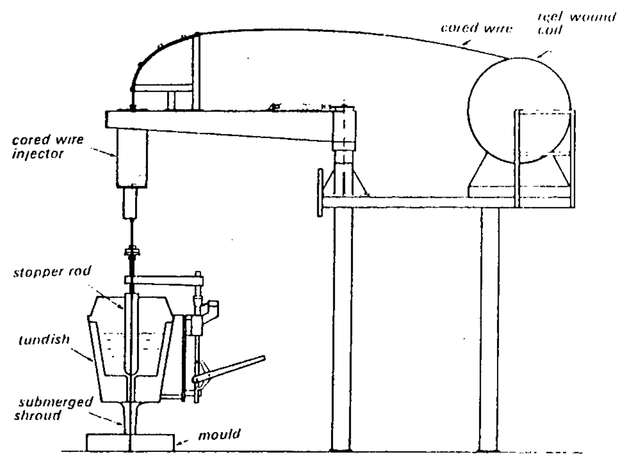

Fig. 9 - CSM cored wire feeding machine via the tundish stopper rod

carried on a swivelling arm to facilitate insertion and to start while casting is in progress.

Works trials

On a 180-t c.c. vertical machine producing 206 x 1065 mm slabs of magnetic *Si* steel at Terni Steelworks, trials were run on one of the two strands of the plant, equipped with a vertical hole submerged nozzle (fig. 10).

Superheat control in the liquid pool was performed by means of the cored wire containing high melting point iron powder (0.007 *C*), while micro alloying of the steel with *Al* was performed using a 99% *Al* powder as the reactive material. The main characteristics of the wires used are given in Table 5, while the operating data concerning the works trials are set forth in Table 6.

In the tests with iron powder, very high wire speeds were explored up to 38 m min^{-1}, to examine the following aspects:

- capacity of powder addition

Table 5 - *Main characteristics of cored wires used for additional cooling and micro-alloying in submerged casting*

cored wire type		HO	Al
powder type		Fe	Al 99
particle size	μm	50-170	50-150
wire diameter	mm	11	11
sheath thickness	mm	1.2	1.2
sheath weight	kg m^{-1}	0.291	0.291
powder weight	kg m^{-1}	0.302	0.119
wire weight	kg m^{-1}	0.593	0.410
filling ratio		1.04	0.409
coil weight	kg	500	500
coil length	m	843	1220

- clogging of the submerged nozzle
- constraints due to solution rate of solid reagents in the liquid steel.

Even with such a high rate of solids addition (25 kg·t^{-1}) there were no problems as regards clogging of the tundish nozzle or of the snorkel, but melting of the wire has shown to present some problems.

In fact the appearance of undissolved parts of the wire was distinguishable in the slab due to the large sheath thickness in comparison with the low superheat level.

Metallurgical effects on the slab

Figure 11 presents the macrographs of the transverse section of the reference and experimental slabs for checking on equiaxed solidification.

The use of modified FAST ensures improved grain refining and increases the equiaxed crystallization area from 17 to 27%. Also noteworthy is the very marked

Table 6 - *Operating data of the trials in submerged casting*

heat n.	cored wire type	feeding time min	casting speed m min^{-1}	wire speed m min^{-1}	casting rate kg min^{-1}	wire feeding rate kg min^{-1}	powder feeding rate kg min^{-1}	wire percentage %	powder percentage %	Al yield %
875	HO	21.0	0.55	38.0	895.0	22.53	11.5	2.52	1.28	--
897	Al	9.0	0.53	12.0	862.0	4.92	1.43	0.57	0.17	100
970	Al	7.5	0.52	12.0	846.0	4.92	1.43	0.58	0.17	--
955	Al	9.0	0.51	8.0	830.0	3.28	0.95	0.39	0.11	86
1010	Al	14.5	0.48	5.0	781.0	2.05	0.59	0.26	0.08	86

effect on the size and linearity of the elongated primary crystals in the columnar area.

In micro-alloying of magnetic steel (0.05 *C*, 2 *Si*, 0.2 *Al*) the addition of up to 2000 ppm *Al* had no adverse effects on castability, while ensuring greater uniformity in the yield of the solute element, which could even be as high as 100%.

CONCLUSIONS

CSM has investigated the possibility of extending application of the FAST to the micro-alloying of steel in the c.c. mould. A stream-protection system (SPAG) has been developed for the continuous casting of small cross-section billets. This effectively reduces the O_2 content of the atmosphere around the steel stream between the tundish and the mould, to values well below those critical for secondary reoxidation of the stream.

The quantity of inert protective gas required is very low. The SPAG system has been integrated with the FAST on the 140 x 140 mm billets plant at Terni Works for feeding powdered microalloying elements such as *B*, *Al*, *Ti*, etc. to the mould, in order to make low-alloy *Al*-killed steel with improved hardenability. Very high yields level, up to 100%, for *B* and *Ti*, have been obtained.

For submerged continuous casting, a modified FAST is being developed for feeding solid material into the mould. This consists in introducing a cored wire through the tundish stopper rod. The wire can play a dual role: namely it can act as cooling agent for control of equiaxed solidification and as alloying agent for microalloying in the mould.

The works trials run on Terni Steelworks 180-t, c.c. machine producing 206 x 1065 mm slabs have shown that the superheat control by powder cooling has a beneficial effect on the extension of the equiaxed crystallization area.

The addition of cored wire containing *Al* to increase the *Al* content from 0.2 to 0.4% has enabled good yields to be obtained for the alloying element without prejudicing the castability of the steel.

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Plasma Torch

Rome BOLLETTINO TECNICO FINSIDER in Italian Sep 85 pp 58-61

[Article by E. Repetto, R. D'Angelo, and P. Tolve]

[Text]

INTRODUCTION

An important objective to be achieved in the immediate future is the control of the temperature of molten steel in the tundish of continuous casting machines so as

to maintain all strands at the same temperature level. Significant improvements are expected, in terms of both central soundness and surface quality of the continuously cast products, when superheating is kept permanently below 10 °K; for example: absence of porosity, reduced segregation owing to the predominance of the equiaxed structure over the columnar structure in the freezing pattern.

Operating advantages and productivity increases should also be forthcoming, since the steel heat can be accepted for casting regardless of whether its temperature has dropped below the specific normal value.

For these purposes, it is necessary to install, preferably in the tundish, a reheating system capable of supporting the heat inputs required for maintaining the temperature of the steel bath constant. Furthermore, it should be highly recommended for this system to possess the following characteristics:

- generation of high-temperature non polluting heat energy that can be used for metallurgical purposes;
- differential heat input to the steel bath that evens out eventual temperature differences between the strands;
- minimization of tundish and plant modifications to be introduced in the continuous casting machine, owing to the installation of the system.

On the strength of these considerations, CSM has carried out an indepth investigation of the various reheat techniques available and reached the conclusion that the plasma torch (and in particular the D.C. plasma torch operating in the transferred arc mode) was potentially the best solution for meeting all the requirements mentioned above.

PLASMA TORCH HEATING SYSTEM

A research program was set up to experiment with a single plasma torch of limited output power, mounted on 9 t tundish of a three strand continuous casting machine for 180 x 240 mm blooms at Deltasider Steelworks, in Aosta.

The reheat system adopted for the experimental work is reproduced schematically in figure 1, showing the position of the plasma torch (8) above the tundish close to the strand 1, the DC power supply (3) and the ground loop made via the molten steel in the tundish (7) and the walls of the continuous casting moulds (9).

The main lines along which the investigation was conducted can be summarized as follows:

- evaluation of the thermal efficiency of the plasma torch by measuring the temperature differentials between strand 1 (reheated) and strand 3, using the non-reheated steel of strand 3 as temperature reference standard;
- determination of the reliability of the ground loop;
- ignition and stability of plasma arc in the presence of non-conductive powders on the steel bath surface in the tundish.

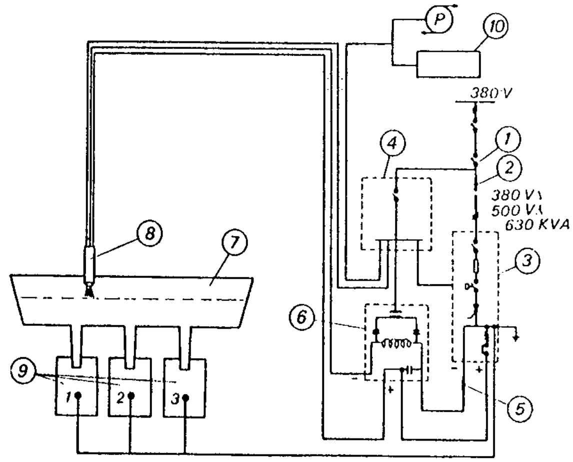

Fig. 1 - Plasma torch reheat system: schematic view

1) main breaker rated at 1200 A
2) three phase transformer
3) SCR power supply
4) control console
5) self-inductance
6) HF ignition circuit
7) tundish
8) plasma torch
9) moulds 1 ÷ 3
10) heat exchanger

Numerous other engineering aspects were also examined so as to collect additional data for the development of an industrial version of a plasma torch having an output power in the 2÷3 MW range, i.e. sufficiently powerful for controlling the temperature of steel baths contained in tundishes of industrial size.

DESCRIPTION OF THE PLASMA TORCH INSTALLATION

The D.C. Plasma Torch used for the investigations has a maximum output power of 250 kW. In table 1 the technical specifications of the torch are given while in figure 2 the characteristic curves of voltage versus amperage for different plasma lengths are represented.

Table 1 - *Plasma torch characteristics*

electrical power	D.C.
arc type	transferred
maximum power	250 kW
maximum current intensity	600 A
dimensions	ø 60 x 340 mm
gas	argon
argon flow rate	5 ÷ 100 l_N/min
cooling water flow rate	12 l/min at 1,5 MPa

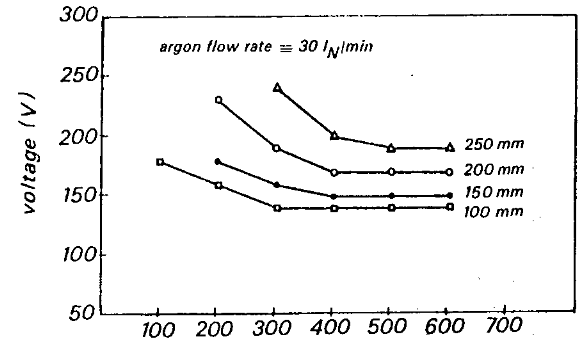

Fig. 2 - Characteristic curves of plasma torch in tundish

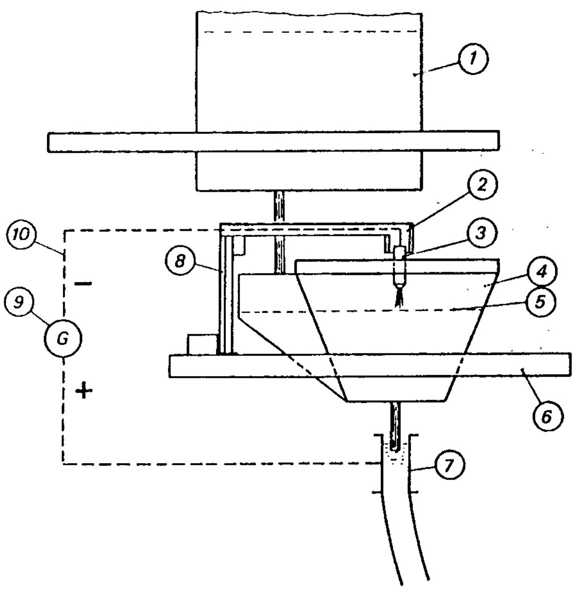

Fig. 3 - Outline of plasma torch installation

1) ladle	6) tundish-car
2) water cooled arm	7) mould
3) plasma torch	8) support column
4) tundish	9) power supply
5) bath level	10) electric cables

In figure 3 is shown in more details the current return circuit made via the molten steel pouring into the mould and via suitable cables connected to the mould wall.

The continuity of the return path at the bloom/mould interface is ensured by the adherence to the mould wall of the conductive skin that forms during the solidification.

In figure 4 is visible the torch supporting arm for moving the torch backwards and forwards along the horizontal and up and down the vertical, fitted with a swivel joint for tilting the torch up to 20 degrees on either side of the vertical. The supporting arm and associated power drive were both installed on the tundish car so as not to hamper operations during replacement of the tundish.

On the basis of a detailed study of the flow field in the tundish, the exact position was established of the torch for beaming the heat energy exclusively on the molten steel drawn towards the nozzle of strand 1.

This determination was essential for (a) obtaining a measurable steel temperature increase with a plasma torch of limited output power, and (b) calculating the thermal efficiency of the torch with sufficient accuracy (i.e. in terms of a rated steel outflow).

EXPERIMENTAL WORK

Particular attention was devoted during the trials to problems associated with the current return circuit and with techniques for reheating the steel.

Torch performance for different operating conditions was determined by varying the *Ar* flow rate (30 ÷ 60 l /min) and/or the length of the plasma jet (100 ÷ 350 mm), but maintaining however in all cases the current drain to approximately 500 A. The maximum output power obtained during all tests was the order of 120÷130 kW.

Some reheat tests were carried out with the torch tilted on the vertical (max tilting, 20°) so as to ascertain the extent of which the overhead clearance of the equipment could be reduced.

Testing of Current Return Circuit

A number of electric conductivity tests were run before installing the plasma torch in the tundish for the purpose of ascertaining the reliability of the current return circuit.

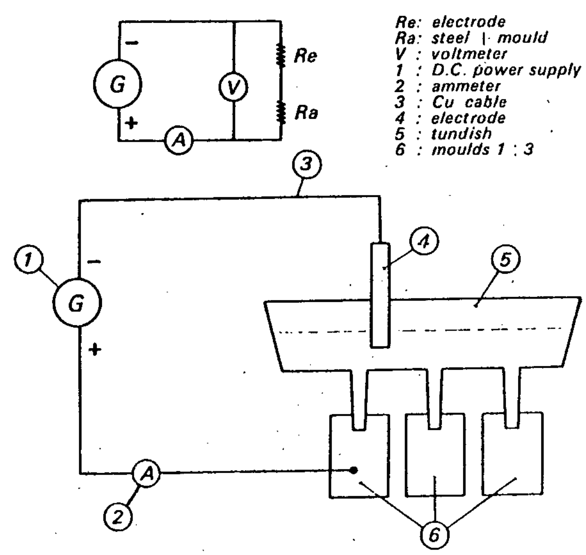

Fig. 5 - Preliminary testing of current return loop

As shown in figure 5 the first set of tests was carried out with one mould only (strand 1) inserted in the return path, using as input conductor an electrode partially immersed in the steel bath and increasing the current intensity progressively up to 500 A.

The second set of tests was carried out with the plasma torch in operation and with all three moulds inserted in parallel into the return path so as to establish the distribution of the load current (~ 500 A) among the three strands. It was found that the current drain of the 3rd mould (i.e. the mould furthest away from the torch) was invariably lower than that of the other two moulds, i.e. 30% of the load current with all three moulds inserted in the return path and 30÷40% of the load current with the 2nd mould cut-out.

No damages was observed on the moulds during any of these tests that could be attributed to the passage of electricity through the return circuit. It was established that the only precaution to be observed in this connection was the need to cut-out from the return path the mould of any strand that has to be shut-down for any reason; this measure prevents possible arcing across the gaps that usually form at the bloom/mould interface when the casting remains stationary in the mould.

Reheat Tests

Given the limited power output of the plasma torch available for these tests, it was decided to use high-precision thermocouples deeply immersed in the steel capable of detecting the temperature increases produced by the heating effect of the torch.

The object of these tests was to determine the extent to which the differential temperature recordings made on strands 1 and 3 could be influenced by adjusting the operating parameters of the torch (voltage, current, output power and length of plasma jet).

In figure 6 are shown the variations in time of the temperature recordings made on strands 1 and 3 during a test carried out holding the output power of the torch to a given level for the entire duration of the test.

Figure 7 shows the same type of graph obtained for a test in which the heat input was supplied by operating the torch in the intermittent mode, varying the output power level.

Figure 8 shows the graph obtained by processing the experimental data acquired during these and other tests; the graph evidences that the rise in temperature of strand 1 remained more or less of the same order of magnitude throughout the tests however much the output power of the torch was increased.

This apparent anomaly is easily explained. Having restricted the load current to 500 A for all tests, the only way to raise the output power was by increasing the voltage, namely the length of the plasma jet, at the expense of torch thermal efficiency; for this reason during the tests, the drop in efficiency was so pronounced that variations of temperature increases produced were almost negligible.

These findings are of particular interest for the design and operation of plasma torches of industrial size, since they show that (a) the technique should be based on the use of short plasma arcs, and (b) the operating method should specify that output power increases are to be obtained by raising the load current and not voltage. Consequently it is expected that for industrial plasma torches the short arc operation will increase notably the thermal efficiency and the figure of 30% or more can be predictable.

From the engineering standpoint, the use of short plasma arcs permits reducing the overall vertical dimension of the reheat system, a substantial advantage considering the small clearances usually available above the tundishes of continuous casting machines.

Engineering Aspects

A number of engineering problems of a more general nature were also examined during the course of the tests in order to expedite development of an industrial version of the system. Prevision was made for ensuring smooth even operation of the plasma torch during start-up and after reaching the steady state. It was ascertained that the heat radiated outwards by the plasma jet could be reduced substantially by enveloping the torch in a rider arch mounted on the tundish cover; the arch could also be adapted to form a high temperature reaction chamber for metallurgical treatment of the steel under an inert atmosphere.

The possibility was also explored of reducing the vertical clearance of the system by tilting the plasma torch with respect to the surface of the steel bath. Finally, it was ascertained that the solution of installing the travelling arm supporting the torch and the associated power drive on the tundish car gave good flexibility of movement without in any way interfering with replacement of the tundish.

CONCLUSIONS

The innovative character of the technological developments described in this paper evidences clearly the importance of the results obtained during the research program for studying problems connected with the installation of a plasma torch in the tundish of a continuous casting machine and, in particular, problems such as: ground loop configuration, stepless measurement of steel temperature, possibility of distributing the overall heat input among several continuous casting strands, radiant heat losses and overall compactness of the equipment. The solutions (often of a general nature) found for these and for other equally important problems have made it possible to ascertain the industrial feasibility of a reheat system for the continuous casting of steel.

The results obtained so far, however, constitute only a first step which should be followed up by further experimental work at industrial level involving plasma torches having on output power in the 2÷3 MW range

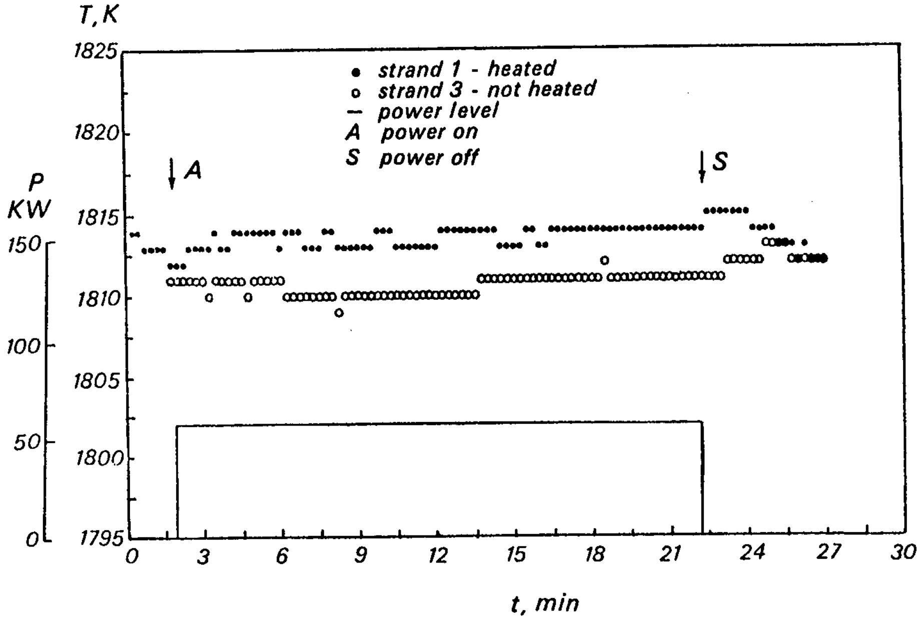

Fig. 6 - Trend of steel temperature (strands 1 & 3)

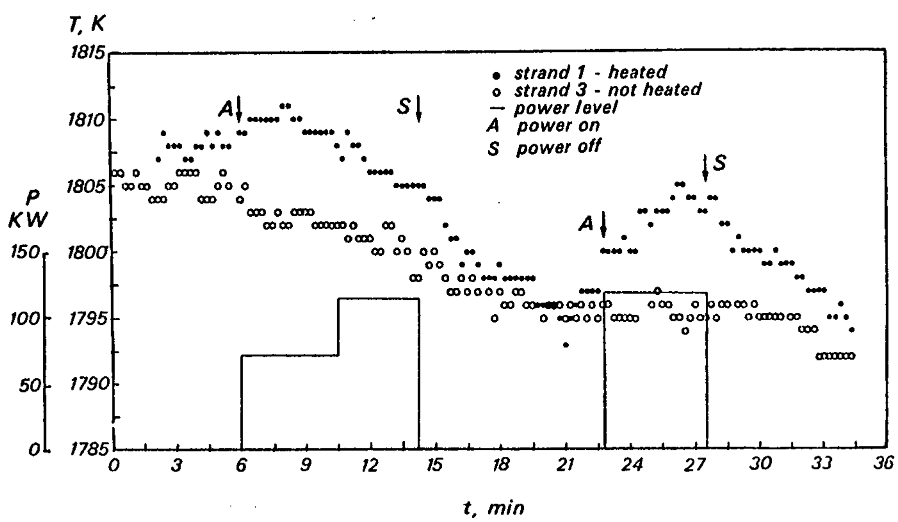

Fig. 7 - Trend of steel temperature (strands 1 & 3)

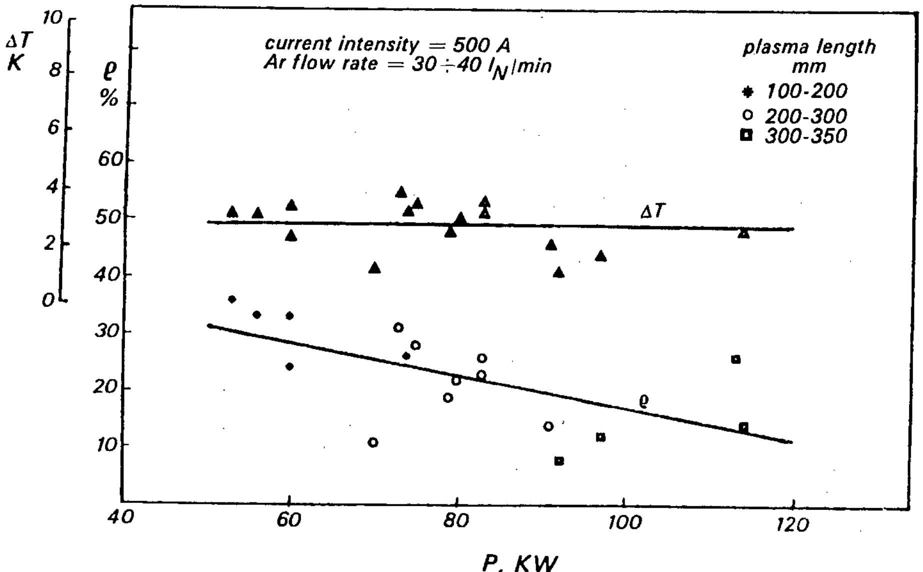

Fig. 8 - Evolution of ΔT in the tundish and of thermal efficiency *vs* plasma torch output power

and installed in very large tundishes, with the object of developing a standard industrial process that can be applied, with minor modifications, to any of the existing types of continuous casting machines.

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Quality Control Instrumentation

Rome BOLLETTINO TECNICO FINSIDER in Italian Sep 85 pp 62-69

[Article by A. Ferretti, M. Pesoli, M. Radicchi, L. Pragiola, and G. Salvemini]

[Text]

INTRODUCTION

At Nuova Italsider's Taranto Steelworks there are four continuous casting machines with eight strands in operation. High strength and aluminium killed steels in slabs 240 mm thick and between 655 mm and 2200 mm wide are produced. A fifth machine in an advanced stage of construction will produce slabs having a cross-section of 243 x 655 ÷ 1360 mm². When this is in operation about 95 percent of the steel at Taranto will be continuously cast.

The ultimate aim is to send the hot slabs directly to the rolling mill without inspection and without cold treatment. To ensure a good product and continuous output, surface defects must be eliminated as far as possible by identifying the reasons for them, while there must be no unscheduled interruption of production. This requirement will be absolutely essential for CC N. 5, since this is designed for hot charging. This article describes the instrumentation and models proposed for monitoring breakout incoming state by measurement of friction and heat exchange in the mould. The instrumentation has been installed on the line two of CC N. 3, where it has also supplied information that has clarified certain aspects of friction and heat exchange between slab and mould during normal casting. This information will also provide a basis for subsequent stages of development of systems for better process control and improved product surface quality.

BREAKOUT

Assumed causes

The trend in modern continuous casting machines is towards higher withdrawal speeds to raise productivity and lower costs. Great attention is also paid to avoiding unscheduled stoppages, especially in plants incorporating direct rolling.

Consequently many research institutes and steelworks have been actively studying possible causes of breakout by installing appropriate instrumentation on strands to ascertain the conditions under which the phenomenon takes place, so as to be able to prevent it happening.

One of the assumed reasons for breakout is that sticking occurs between the recently solidified shell in the upper part of the mould, with the result that the shell breaks in the stuck zone owing to reciprocal movement of slab and mould in the vicinity thereof (fig. 1.1). Fresh liquid steel penetrates into the break thus formed and comes into contact with the mould (fig. 1.2). If the material is firmly stuck the solidified shell breaks again (fig. 1.3) and the process proceeds in this manner until the slab leaves the mould where breakout occurs.

It ensues from these simple considerations that the time available to give the alarm when sticking occurs is:

$$t = \frac{h}{v}$$

where h is the height above the mould bottom where the break forms and v is the average withdrawal speed at that moment.

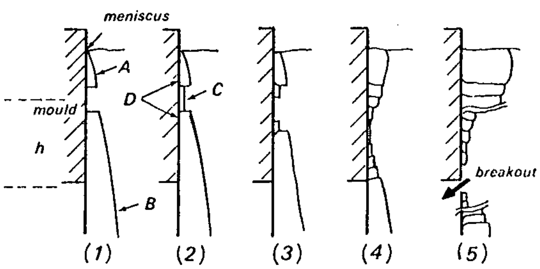

Fig. 1 - Process of breakout caused by sticking (3)
A: stuck shell, B: withdrawn shell, C: new solidified shell, D: ripple mark

Summary of prediction methods

There are sound reasons for running continuous casters in such a way as to avoid breakout and to ascertain what factors may indicate anomalies in the primary cooling process, namely:

a. loss of production
b. cost of unscheduled maintenance
c. lack of feed to hot-charged units downstream.

Breakout happens unexpectedly and very infrequently. The instrumentation used for monitoring and for providing input data for the prediction models must be simple and require little maintenance, yet it must be very reliable to ensure it does not raise false alarms or fail to give warning of when there is a critical situation.

Methods tried for predicting dangerous operating conditions that may lead to breakout or incipient breakout are of three basic types:

1. Measurement of friction between slab and mould [3, 4, 5]
2. Measurement of heat exchange [2, 6]
3. Measurement by thermocouple of local temperature rises on the faces of the mould [7].

Our prediction system is based on methods 1 and 2. The third method was rejected as being too expensive in terms of instrumentation capital and maintenance costs, and because of time factor considerations.

The friction method instead can even indicate a critical situation that deteriorates to breakout.

DEVELOPMENT OF BREAKOUT MONITORING DATA ACQUISITION SYSTEM

The data acquisition system for breakout prediction has been organized on Strand 2 of Continuous Caster N. 3 at Nuova Italsider's Taranto Steelworks.

To be able to acquire data on random events such as breakout a system is needed that remains efficient for a long time and which can provide data even when the plant is unattended. The system installed in December 1983 and still in operation is, in fact, designed to operate in such a manner, requiring no staff and being complete with a data bank concerning about 35 heats prior to breakout.

The method evolved for monitoring breakout incoming state utilizes an on-line model which evaluates slab-ingot interaction on the basis of a set of thermal and mechanical variables. With the transducers installed it is possible to evaluate:

a. friction between slab and ingot by measurement of the force necessary to produce mould oscillation
b. General heat exchange, non symmetrical heat exchange between mould sides
c. Thickness of solidified shell, using a simplified mathematical model built by the CSM.

One or more measurement lines has been organized for each of the points listed. The data acquisition system utilized (fig. 2) consists essentially of:

- transducers to measure relevant physical parameters
- signal conditioning system for parameters that cannot be measured directly
- data acquisition system
- area computer
- floppy disc unit to dump acquired measurements.

When it is necessary to examine data collected on a breakout that has occurred or for other reasons, the relevant heats are transferred from hard disc to floppy disc so that they can be examined at the CSM or elsewhere, as required.

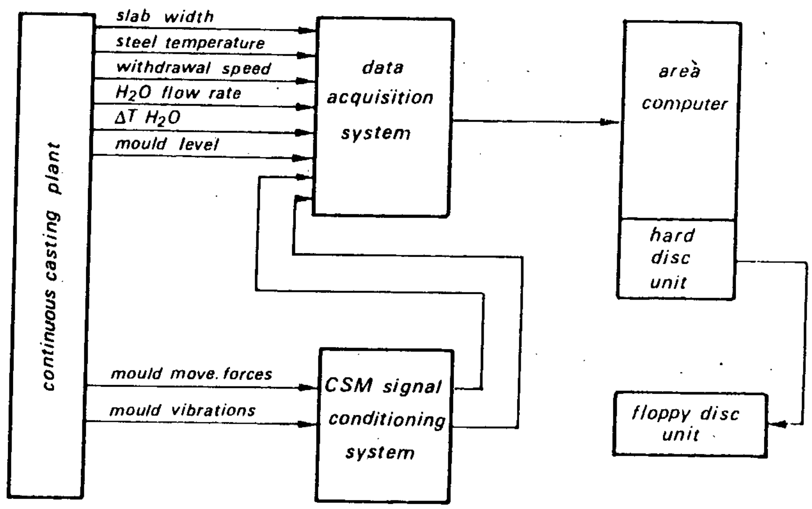

Fig. 2 - Taranto continuous casting breakout prediction

Variables acquired and instrumentation installed

The block diagram of the data acquisition and signal conditioning system installed is illustrated in figure 2,

Table 1 - *Variables acquired*

variable	record	data acquisition period (sec.)	remarks
sequence number	1		
slab width	2	5	
heat number	3	--	
steel type	4, 5	--	
steel temperature	6		
withdrawal speed	7	5	
mould vibrations	8	5	
ingot move. forces peak v / mean v	9 / 10	5	
water flow rate broad side A	11	15	
water flow rate broad side B	12	15	
water flow rate narrow side A	13	15	
water flow rate narrow side B	14	15	
Δt water broad side A	15	5	ΔT (LLA)
Δt water broad side B	16	5	ΔT (LLB)
Δt water narrow side A	17	5	ΔT (LSA)
Δt water narrow side B	18	5	ΔT (LSB)
ingot level	19	5	
time	20	—	
date	21	—	

while the acquisition channels are summarized in table 1.

In the case of thermal variables, use was made of probes already installed on the plant to measure temperature difference between incoming and outgoing cooling water and the water flow rate on the four sides of the mould. These data were already being acquired by the basic process computer system and dumped onto discs for processing at the CSM.

As regards the mechanical variables vibration and force, special lines had to be set up to acquire and condition signals connected to the data acquisition system. The relevant instrumentation was designed and built at the CSM.

All the signals coming from the continuous caster are scanned every five seconds by the data acquisition system which transforms them into serial signals that are sent to the area computer. If required, all the signals can be displayed on a monitor as instantaneous values and as levels compared with full-scale values.

RELATION BETWEEN SLAB-INGOT FRICTION AND WITHDRAWAL SPEED FOR STEELS ON CC 3

General

It is evident from the parameters monitored that friction between slab and ingot, and the trend of this in relation to withdrawal speed is very significant.

Friction depends on the chemicophysical characteristics of the powders and can also be tied in with other important phenomena such as heat flow in the mould, for instance [8]. Friction that occurs in the mould can be explained by assuming a mixed mechanism [8, 9, 11], the sum of two terms, the first of which $[F_s(t)]$ is due to the solid-solid contact between the layer of solidified powders and the mould, and the second $[F_l(t)]$, to shear stresses that occur in the liquid layer of powders moving between slab and mould.

If it is assumed that the level in the mould is constant then total friction can be written as:

$$F(t) = F_s(t) + F_l(t)$$

The two terms are derived from the following equations [8]:

$$F_s(t) = (1-\alpha)\,\mu_s A \bar{N} \frac{(\dot{x}-u)}{|\dot{x}-u|} = F_s^{\circ} \frac{(\dot{x}-u)}{|\dot{x}-u|}$$

$$F_l(t) = \alpha \mu_l A \frac{(\dot{x}-u)}{d_l} = F_l^{\circ}(\dot{x}-u)$$

where:

A = slab/mould contact area
$\bar{N}$ = mean static pressure exerted by liquid steel
μ_s = static solid friction coefficient
μ_l = lubricating film friction coefficient
d_l = mean thickness of lubricating film
α = fraction of liquid lubrication area
$\dot{x}$ = instantaneous velocity of mould movement
u = withdrawal speed

About 90% of the total friction is hydrodynamic, especially in the upper part of the mould where the temperature is highest. In the lower part of the mould solid-solid friction may be more important, as indicated by the greater wear that occurs here [11].

Experimental data

Experimental friction values have been processed and plotted against slab withdrawal speed; it ensues that friction decreases as speed increases (fig. 3). The equation of variation has not been sought but the trend for the speeds indicated is similar to that reported by Nakato and by Wolf [8, 12].

To better characterize the phenomenon, the mean friction value was ascertained during the constant speed periods to acquire a characteristic value for each speed. When performing these calculations a number of observations close to the transients were eliminated so as not to influence the mean by anomalous values that occur when there are speed variations.

The analysis was made by collecting together steels of a given group. Figure 3 illustrates the trend of the frictional force as a function of withdrawal speed for steels of the first group ($C \leqslant 0{,}06\%$; $Mn \leqslant 0{,}29\%$; $Al \leqslant 0{,}07\%$; $S \leqslant 0{,}02\%$; $P \leqslant 0{,}015\%$; $Si \leqslant 0{,}02\%$). The value of the forces is that measured during casting, divided by the perimeter of the slab, stripped of the off-load test forces, so that account is taken only of slab/mould friction. The ensuing curve shows a decided decrease in friction as speed increases. This trend becomes particularly evident at values greater than 800 mm/min, in line with the findings of other workers [8, 9].

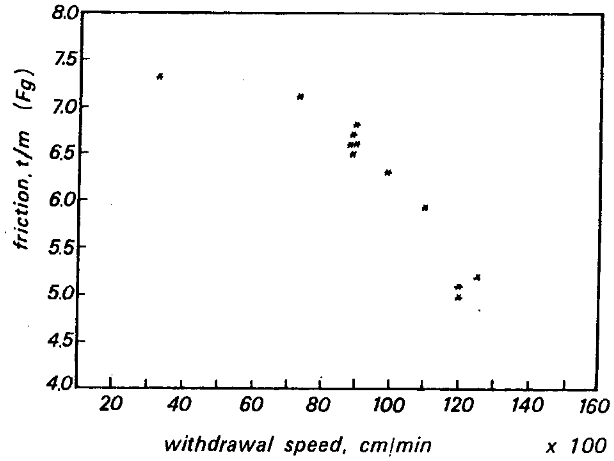

Fig. 3 - Friction vs withdrawal speed ($C \leq 0.07\%$)

Knowledge of these curves obtained during normal casting provides useful pointers for running the continuous casting process, since there is a characteristic standard curve for each type or group of steels, depending on type of powder. Every deviation from the standard values can be interpreted as a situation favourable for the formation of defects on the slag surface [9] or which may actually result in breakout. From the practical aspect, this situation can be signalled by a warning device on the control panel. Indications on type of powder to be chosen can also be derived from friction measurements, as can the best withdrawal

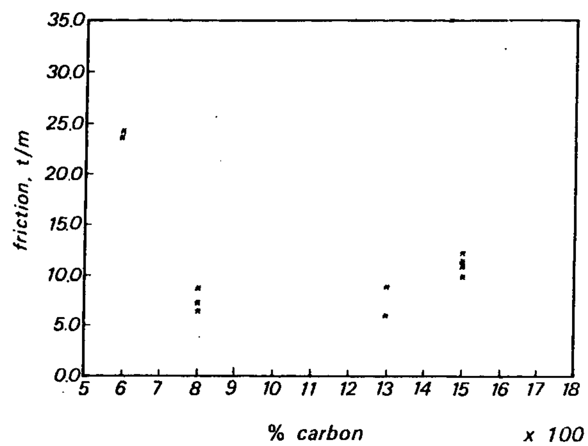

Fig. 4 - Friction vs carbon ($0.6 < V < 0.9$ m/min)

speed for a given type of powder [12]. This information is a great help for the production of slabs needing no surface inspection, especially in view of the present trends towards faster withdrawal speeds and the introduction of hot charging downstream.

Figure 4 illustrates the effect of percent carbon on friction at withdrawal speeds between 0.6 and 0.9 m/min.

SIMPLIFIED SHELL THICKNESS PREDICTION MODEL

Temperature of the steel in the mould, especially that of the solidified shell is very important as regards breakout. Hence it is essential to incorporate these data with the others that must be examined to establish possible correlations with the phenomenon.

Water flow rates and temperature differences at the incoming and outgoing ends of the coolers, as well as the steel superheat ΔT are important on their own and also in combination with the withdrawal speed. Interdependence of these parameters can be demonstrated by calculating the thickness of the solidified shell where the slab leaves the mould. Programs capable of determining this thickness, however, are quite complex and the computer time needed is incompatible with on-line control requirements.

It was considered advisable, therefore, to run a series of simulations with the program developed by the CSM, so as to obtain a schedule of solidifed thicknesses for a broad range of operating conditions. As the mathematical model has not yet been calibrated, the thicknesses derived in this manner are relative, not absolute.

The ensuing values have been analysed using the CSM's system so as to obtain a mathematical expression that gives the solidified thickness as a function of parameters that can be measured on the plant or be readily derived therefrom.

These parameters are heat flow per square metre per hour Q (Kcal/m²h), withdrawal speed v (m/min) and difference between temperature (ΔT) in the tundish T and that of solidification T_s. Simulations performed covered all possible combinations of the following values:

Q (Kcal/m²h)	0.5×10^6	0.6×10^6	0.7×10^6	0.9×10^6	1.1×10^6	1.3×10^6
v (m/min)	0.4	0.6	0.9	1.2	—	—
ΔT (°C)	15	35	55	—	—	—

These values define the set of points within which the final expression derived for the solidified thickness holds good.

Withdrawal speed can be measured on line, while as regards the parameter Δt, the tundish temperature is normally measured and the solidification temperature has been calculated from the analysis of the cast steel by the relation

$$T_s = 1537.46 - 82.42\,(\%\,C) - 5.814\,(\%\,Mn) + \\ - 41.4\,(\%\,S) - 150.8\,(\%\,P) - 10.88\,(\%\,Si) + \\ - 37.3\,(\%\,Al).$$

To calculate the heat flow it suffices to known the flow rate Q_L and the temperature difference ΔT_L of the mould cooling water, as well as the depth of steel h in the mould.

The quantity of heat W extracted per unit of time is:

$$W = 60 \times C \sum_{i=1}^{4} Q_{Li}\,\Delta T_{Li} \qquad \text{(Kcal/h)}$$

where:

Q = flow rate of i-th face (l/min)

ΔT = increase in cooling water temperature (°C)

C = specific heat of water (Kcal/l. °C)

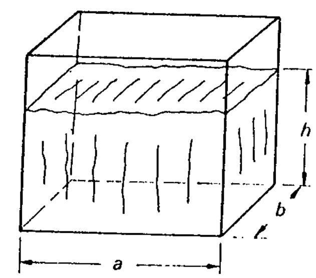

Fig. 5

The ingot area in contact with the steel is given by

$$A = 2\,h\,\{a + b\}\ (\text{m}^2)$$

Heat flow per square metre per hour will thus be:

$$\Theta = \frac{W}{A}\ (\text{Kcal/m}^2\text{h})$$

With all these data available, the thickness (in cm) of the solidified shell can then be calculated by the expression:

$$S = 2.5 \times 10^{-6} \times \Theta + \frac{11.695}{exp\,(4.175\,v)} + \\ - 13.04 \times 10^{-3}\,\Delta T - 223.55 \times 10^{-3}$$

The hypothesis regarding breakout formation indicated before, permits several points to be made on the level of sensitivity of the transducers, particularly as regards measurement of frictional forces, which cannot be quantified any other way.

Let it be assumed that Steel PO40 is cast at a withdrawal rate of 0.8 m/min with the level 6 cm from the top edge. It can be taken that the solidified part of the steel grows uniformly from the meniscus to the end of the mould. It ensues from the simplified model that 30 cm from the meniscus the thickness of the solidified shell is about 7.6 mm.

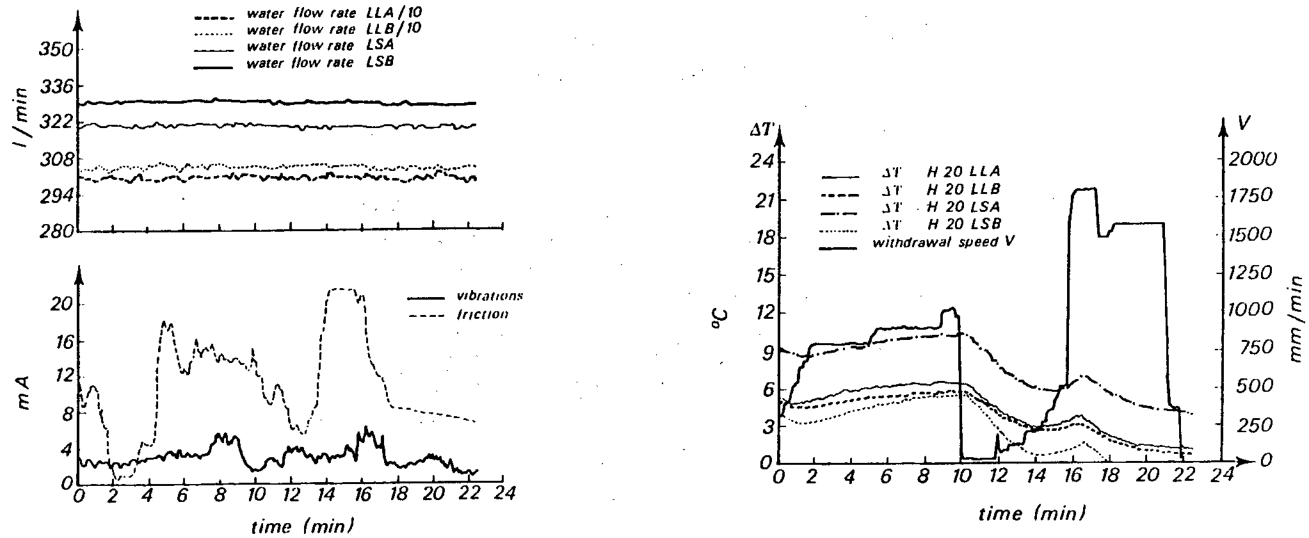

Fig. 6 - Heat n. 2828 (26-8-84 - Steel PO43)

The model described previously, together with the points made on breakout formation permit an estimate to be made of what the measured force corresponding to a slab-mould break could be. A force of about 22 t is needed to produce an 80 cm long transverse tear half way up the mould, assuming an average UTS of 3.2 kg/mm² for the solidified steel [13, 14]. This figure is considerably higher than the frictional force measured during normal continuous casting.

These elements are confirmed by the figure 6 diagrams which show that the frictional force went to full scale before the occurrence of breakout, indicated by the big increase in withdrawal speed.

BREAKOUT PREDICTION MODELS

A breakout prediction model (figs 8 and 9) has been proposed on the basis of the measurements recorded during normal operations and observations made on the limited number of breakouts on Strand 2, CC N. 3 at Taranto Steelworks. The program indicated by the flowchart must be implemented and run on the area computer. The response must thus be considered as an indication of danger rather than a sure prediction, and should prompt a check on running conditions and adoption of cautious operation.

With:

F_T force measured on ingot movement arm or « friction» between slab and ingot

V withdrawal rate (m/min)

ΔT rise in temperature of cooling water for the four plates forming the mould, namely broad side A (LLA), broad side B (LLB), narrow side A (LSA) and narrow side B (LSB) (°C)

L_b slab width (m)

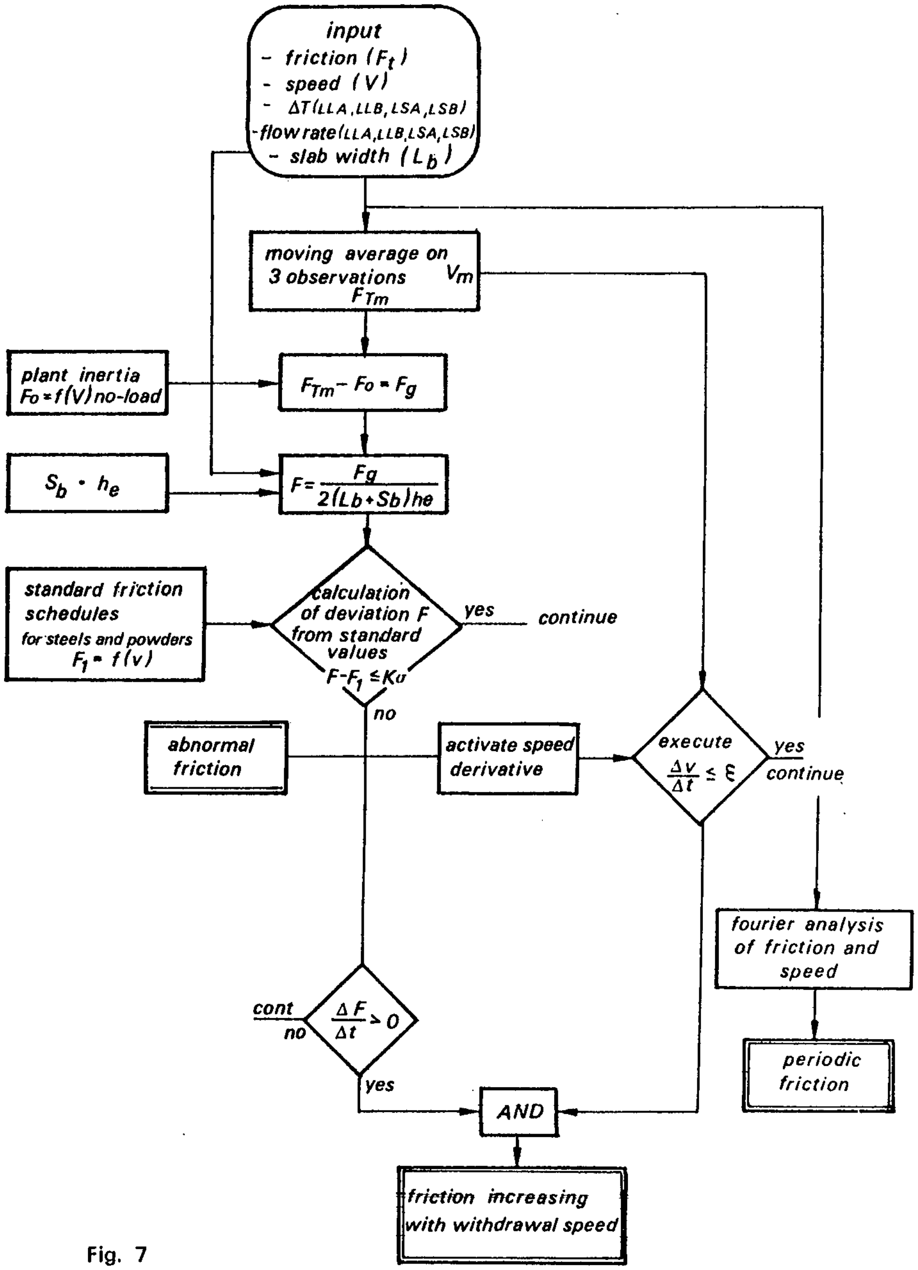

Fig. 7

The other variables acquired are described in table 1. Model input data are the electrical signals from the transducers conditioned by the CSM rack and acquired every five seconds, except for water flow rates that are acquired every fifteen seconds.

In the case of the friction and withdrawal speed signals a moving average of three observations is taken, F_{T_m} and V_m being the products of the moving average filtration. This leads to a slight delay on the signal processed but it enables spurious signals to be eliminated and gives greater weight to trends. Before computing the moving averages the speed and force signals are derived and sent to a Fourier operator.

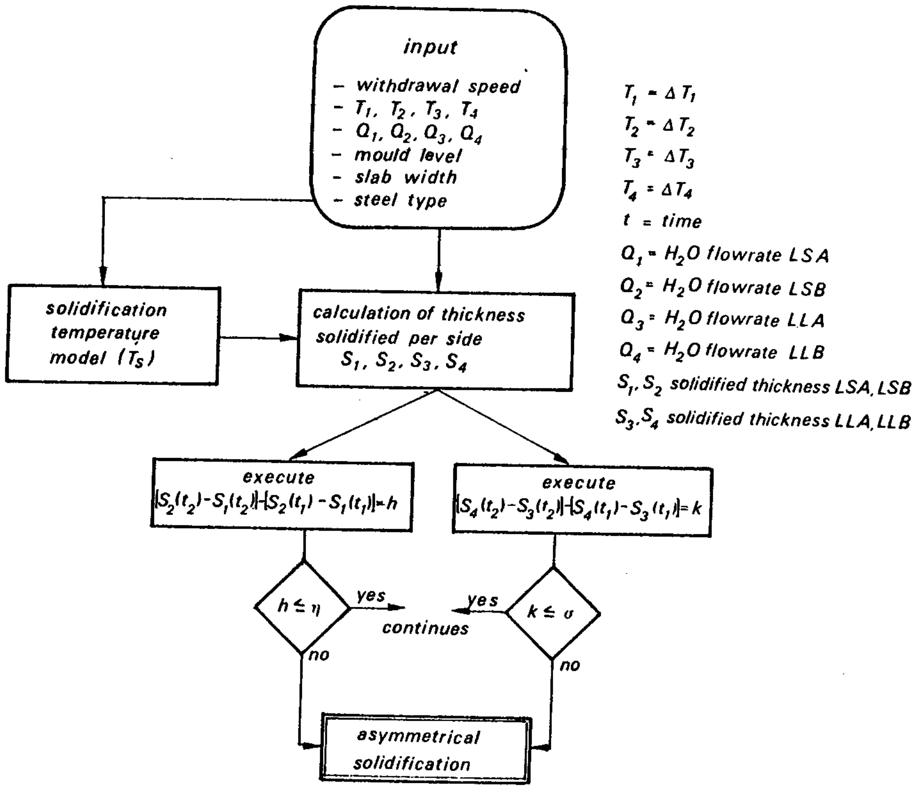

Fig. 8

The value F_{T_m} is stripped of the force due to inertia of the plant $F_o(v)$ (characteristic of every kind of machinery) and is then stored as a schedule or an experimental function.

Let $$F_g = F_{T_m} - F_o(v)$$

where F_g is the frictional force between slab and mould for the current dimensions of the casting operation concerned. Owing to variability in slab width, it is advisable to ascertain specific friction ($t \cdot m^{-2}$) so as to be able to compare different casting runs.

Hence:

$$F = \frac{F_g}{2(Lb + Sb)\, h_e} \quad [t \cdot m^{-2}]$$

where h_e is the effective height of the steel meniscus above the bottom of the mould h less a separation coefficient α which can be derived from the mathematical solidification model.

$$h_e = h(1 - \alpha)$$

with Lb and Sb slab width and thickness.

It is assumed that the standard specific friction curve, derived experimentally as a function of withdrawal speed for the type of steel and powder used, has already been loaded into the computer.

The next step is to compare the current friction value with that of the standard curve. If F_1 is the standard value at the current withdrawal speed, then

$$|F - F_1| \lesseqgtr K\sigma \quad K > 1 \ (*)$$

where σ is the standard deviation typical of this kind of measurement.

If the comparison gives a value $\leqslant K\sigma$ the figure can be taken to be normal and the program « continues' » in the sense that it then goes on to examine the next item of data. If, instead, the comparison gives a result of $> K\sigma$, friction is abnormale and an early warning sign comes on.

ABNORMAL FRICTION

This signal also activates the speed derivative and the derivative of the signal itself.

In data acquired on « normal » casting runs, it has been observed (fig. 3) that frictional force decreases with increase in speed, at least for Group 1 steels and for speeds up to 1.2 m/min. This trend is also confirmed by Nakato for low withdrawal speeds (fig. 9). If the trend is different the situation is abnormal and a warning must be given. This was the situation in the breakout due to sticking recorded at Taranto (fig. 6).

Using an initially unconstrained logic, it is interesting also to compare the trend pattern. This condition imposes a quantitative limit on what has been indicated earlier, the purpose being to avoid useless alarms. Being an « end » condition, it must be parameterized on an adequate number of cases. A further condition is thus imposed, namely that the difference of the derivatives must also be positive and greater by a value H with $H \geqslant 0$.

The condition that the derivatives of friction and speed must also be positive is implemented by a coincidence circuit (AND) which ativates the signal

FRICTION INCREASING WITH WITHDRAWAL SPEED

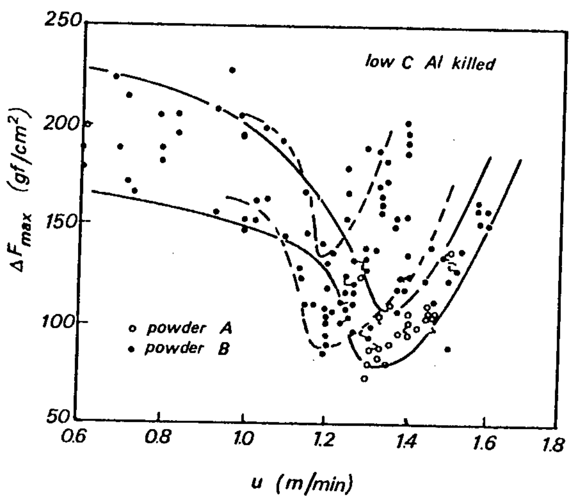

Fig. 9 - Effect of withdrawal speed on the maximum amplitude of frictional force

(*) Coefficient K must be evaluated on a considerable number of breakouts.

Independently and at the same time as the above measurements the model examines ΔT, flow rates Q_1, Q_2, Q_3 and Q_4 for mould sides LSA, LSB, LLA and LLB respectively, and the inputs needed to calculate solidified shell thickness as per the simplified model indicated before.

Neglecting what is happening in the corners and indicating calculated thicknesses as S_1, S_2, S_3 and S_4, and $t_2 = t_1 + \Delta T$ ($\Delta T = 5 \div 10$ s), the computer executes:

$$[S_2(t_2) - S_1(t_2)] - [S_2(t_1) - S_1(t_1)] = h$$

$$[S_4(t_2) - S_3(t_2)] - [S_4(t_1) - S_3(t_1)] = k$$

This operation compares variations in solidified thicknesses between opposite sides at different instants. If times t_2 and t_1 are close together, $t_2 - t_1$ is about one minute or less, and the operation is very precise, since instrumentation stability is good for short periods.

A situation that upsets the equilibrium, perhaps caused by an orifice in the box nozzle being clogged, can lead to a dangerous situation quite independently of friction. Once having established two values η and σ by experience, beneath which imbalance can be considered normal, the signal is given:

ASYMMETRICAL SOLIDIFICATION

In the recorded breakout due to sticking, a major imbalance of extracted heat occurred which would have led the model to give the warning indicated.

Examination of the data shows that breakout can happen even if the friction trend is periodic with a wide amplitude of oscillation, since large variations in mechanical load also affect withdrawal speed. To analyse this behaviour Fourier analysis is performed on the friction and speed signals. If such behaviour is present in the two signals the computer gives the warning:

PERIODIC FRICTION

VIBRATION MEASUREMENT

During observations on Strand 2 of CC N. 3, it was noted that the slab transfers a certain amount of mechanical energy to the plant in the form of vibration wave packets with a component around 1200 Hz. Due to the nature of these vibrations the idea emerged that they may be caused by microsticking of slab and mould. It was decided to measure these vibrations, therefore, to see whether they may be associated with dangerous conditions when they are present in great number and their amplitude is considerable. An accelerometer was thus installed and a filtration and detection system implemented. This selects particular frequencies and provides a dc output proportional to the amplitude and repetition frequency of the wave packets.

The accelerometer is mounted on the fixed side of the mould being disconnected and reconnected every time the mould is changed.

When breakout occurs, the vibrations demonstrate lower sensitivity of slab/mould friction (fig. 6).

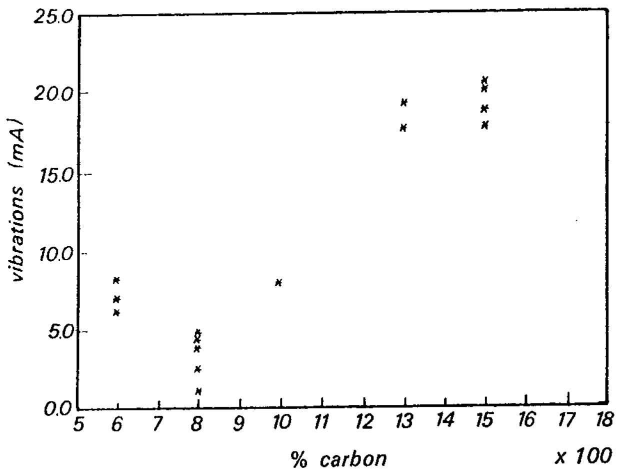

Fig. 10 - Vibrations vs carbon (0.6 < V < 1.0 m/min)

Under normal running conditions, the plot of the average level of vibration versus % *C* in the cast steel indicates a trend similar to that for friction, with a minimum around 0.08% *C* (fig. 10). Vibration values have been measured at withdrawal speeds of between 0.7 and 0.9 m/min for various heats.

CONCLUSIONS

Strand 2 of CC N. 3 at Nuova Italsider's Taranto Steelworks has been instrumented to acquire and process mould-vibration, mould-movement-force and mould-heat-exchange signals.

An investigation was run to build a model that can use these measurements to predict abnormal solidification conditions that my lead to breakout.

It has been found that friction and heat exchange measurements are the most interesting for prediction purposes. The system has been in operation for a short period, but the results and pointers are sufficiently interesting to warrant continuing the trials.

The termal model was tried on 19 heats during one of which breakout due to sticking occurred (Heat 2828). The trials are still under way, but from the heats monitored it ensues that in « normal » operation the measured imbalance in temperature differences of mould cooling waters remains within 0.2 °C, while in the run when breakout occurred the figure was 0.6 °C.

The model is still in course of refinement to take account of any lack of symmetry there may be in the distribution of cooling waters.

The method is a global one and thus filters outminor events. However, it is considered interesting because without modifying the plant it can indicate heat exchange imbalances that may cause breakout.

The friction model is more complex because it works on levels characteristic of a given type of steel and must take account of a greater number of heat parameters. Under steady-state conditions, friction depends on the withdrawal speed, the type of steel and the kind of lubricating powder.

Under dynamic conditions, especially if there are large speed variations at the start of casting, the frictional force measured can be very high without there being any danger of breakout, however. Account has to be taken of this in the model which can be a limiting factor in the case of rapid speed variations.

This result has been found by other research workers [9, 15] who indicate a 60% possibility of predicting breakout by friction measurements. If heat measurements are combined with friction monitoring it is felt that this level of prediction can be raised.

In addition, knowledge of the frictional force between slab and mould during primary cooling of the continuously cast steel permits a well-founded study to be performed on shell lubricant efficiency.

Aspects still requiring evaluation are as follows:

a. friction as a function of withdrawal speed for various types of steel
b. Measurement of friction with various types of powder and different types of steel
c. Correlation between friction and the number of surface cracks, plus a study to minimize these.

Much work remains to be done to clarify the influence of input variables (powders, steel type and machine parameters) on the measurable variable « friction » and the effect of this on product quality.

The latter problem calls for the development of instruments suitable for automatic analysis of slab surface quality and the creation of a data bank which permits observation of product improvements on a great number of data over a long period of time.

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Electromagnetic Probe for Quality Control

Rome BOLLETTINO TECNICO FINSIDER in Italian Sep 85 pp 70-72

[Artidle by G. Canella, F. Monti, F. Rossetti]

[Text]

INTRODUCTION

The development of an electromagnetic system for hot detection of surface defects in continuously-cast slabs is essential for implementing direct rolling, with all its inherent advantages.

Presently known systems are based on a variety of solutions, such as optical inspection of slabs by telecameras with infra-red illumination [5] or with low-angle or direct lighting [2, 4], and cooled eddy-current probes [1, 3].

Of these solutions, those involving telecameras are used on line for detecting large defects, while although eddy-current probes have given promising results on small defects in the laboratory, the authors know of no industrial applications.

During a research project [6] supported by the ECSC, the CSM with Nuova Italsider tried out a new type of probe based on the electromagnetic resonance principle for cold detection of surface defects in slabs.

The results proved the great possibilities of the system and prompted the work reported here which was concerned with the design and construction of a prototype resonance probe suitable for hot detection of surface defects.

NOTES ON RESONANCE METHOD

The electromagnetic resonance probe consists of an RLC oscillating circuit, a variable frequency AC power supply and a rectifying circuit for the output signal from the coil terminals.

The operating principle is as follows:

The oscillator/metal surface system is excited at a point where the surface has no defects so as to obtain an output taken as being the «zero reference» signal.

The presence of a defect – depending on type – changes the amplitude and/or resonance frequency of the circuit, causing a variation in the zero signal. The variation is proportional to the size of the defect up to a maximum depth of $\sim$ 20 mm [6]. Hidden defects can also be detected up to $\sim$ 1 mm below the surface.

Another very important feature of the method is that it permits operation with a lift-off of up to about 20 mm, between the probe and the metal, so for hot detection an adequate heat-protection system can be interposed.

PROTOTYPE HOT TESTING PROBE

The photograph in figure 1 and the vertical section in figure 2 show the prototype air-cooled electromagnetic probe for hot detection of surface defects in continuously cast slabs.

The system for thermal protection of the probe and air cooling of the «resonant circuit» proved effective in all the trials performed.

The main features of the prototype hot testing probe can be summarized as follows:

- temperature of circuitry maintained within the safety limit of $\leqslant$ 80 °C
- adequate heat protection for cables carrying power supply, output signals and temperature monitoring

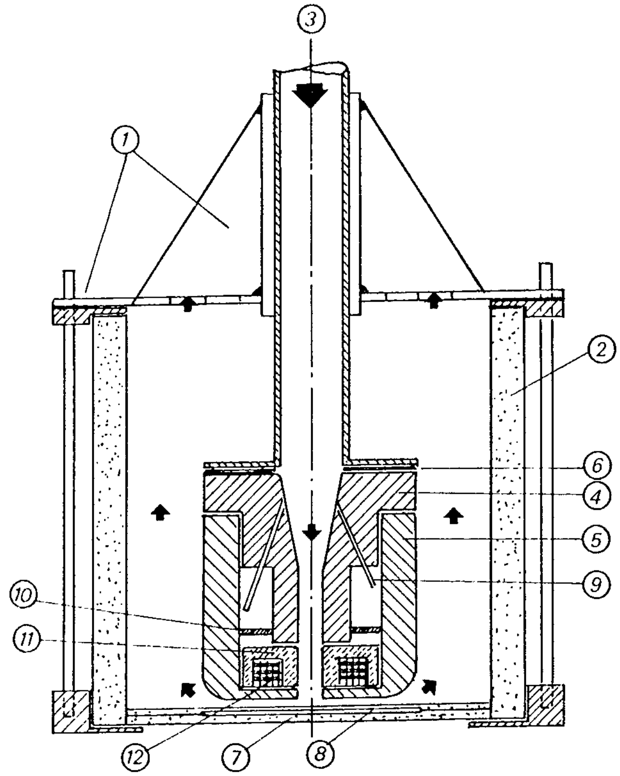


Fig. 2 - Hot testing electromagnetic probe

1. inox carrying structure
2. refractory chamber
3. cooling air duct
4.-5. dielectric support
6. coil height adjustment
7.-8. double refractory plate, air spaced
9. cable ducts
10. circuitry
11. ferrite core housing
12. coil

signals of resonant circuit, by running them through the cooling air line

- easy interchangeability of all probe components and possibility of inserting the ferrite core
- minimum working lift-off $\simeq$ 16 mm.

EXPERIMENTAL TESTS

Experimental tests were run on 150 mm long offcuts of 200 mm diameter steel bar, with the twofold aim of:

- checking the soundness of the cooling system which was done by plancing the probe on a hot specimen ($\sim$ 1000 °C) and recording the temperature change in the resonant circuit.
- checking the effectiveness of the hot testing system by comparing the signals (from notches) with those obtained at room temperature.

Figure 3 illustrates the experimental hot measurement set-up which consists of:

- prototype probe complete with:

flow meter for measurement of cooling air flow rate; thermocouple for measuring temperature of circuitry; variable frequency oscillator for the excitation signal; means for detecting output signals of hot and cold notches. The probe output signal is sent to an oscilloscope where the DC is suppressed and the signal is buffered, filtered if necessary (low-pass and high-pass) then passed to a multichannel chart recorder;

two steel samples, one with two 2-mm deep notches (one on each of the two faces) the other with 5 mm and 7 mm notches all 50 mm long. The samples, duly lagged with fibreglass, were heated to a maximum

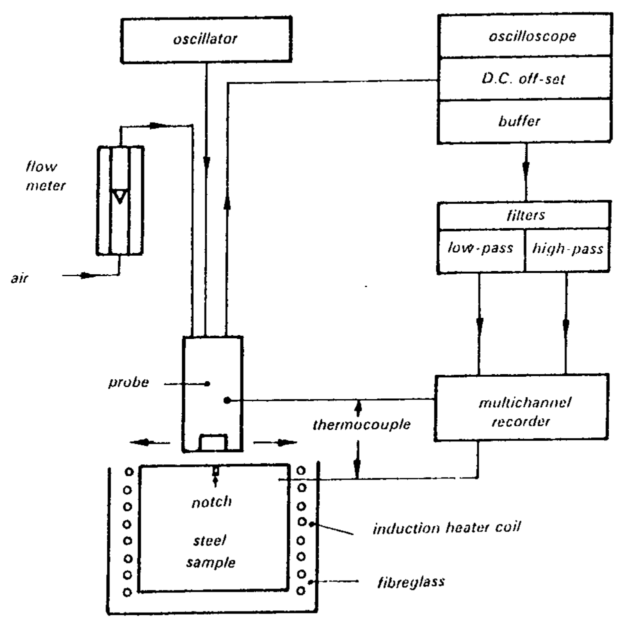


Fig. 3 - Hot measurement instrumentation block diagram

temperature of 1000 °C in a high-frequency induction furnace, sample temperature being monitored and controlled by a thermocouple.

The most significant results are given later.

COOLING SYSTEM

As confirmation of the suitability of the cooling system, figure 4 reports two typical probe interior temperature trends, which represent the thermal balance ensuing from the outside heat supplied to the hot sample and the heat removed by the cooling air.

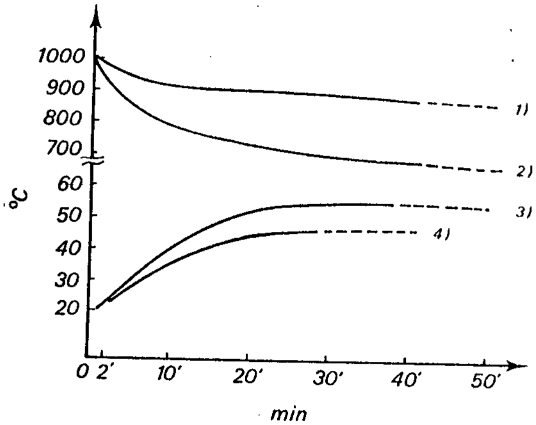


Fig. 4 - Temperature *vs* time of steel sample and relevant temperatures *vs* time of probe electronics
(1), (2) sample temperature trends for two different laggings
(3), (4) relevant inner temperature trends of air cooled probe

It is evident from analysis of the curves that:

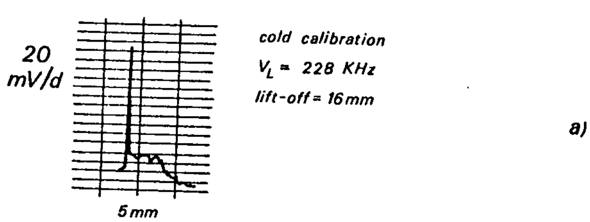
- the cooling air is sufficient to keep the temperature inside the probe at below 60 °C (Curves 3 and 4) for a long time (~ 30 minutes) in both hot sample cooling situations, namely:

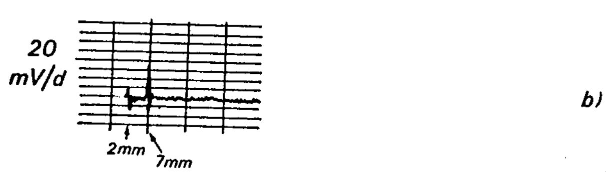
Curve 1 - Initial temperature of ~ 1000 °C decreasing to 900 °C in about 15 minutes and then remaining virtually constant for another 20 minutes

Curve 2 - Initial temperature of ~ 1000 °C decreasing to 780 °C in about 15 minutes and then to 680 °C after a further 20 minutes.

DEFECT DETECTION

Figure 5 shows typical examples of hot measurements, with recordings of the response signals from notches cut in the samples. Measurements were made using a ferriteless coil, with lift-off of 16 mm and frequency of 228 kHz.





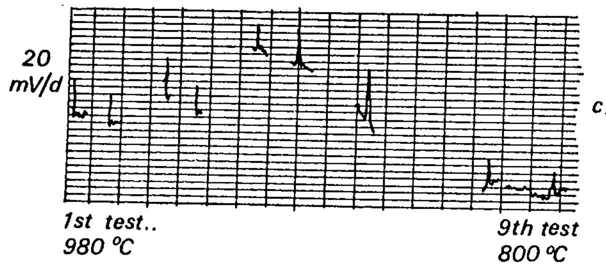


Fig. 5 - Hot detection of artificial notches 2,5 and 7 mm deep
a) cold calibration with 5 mm deep notch
b) test at 900 °C of 2 and 7 mm deep notches
c) 9 hot tests from 980 °C down to 800 °C of 5 mm deep notch

The probe was moved by hand during the tests, so it was affected by noise due to the vibrations generated by the irregular rate of movement as well as by the edge-effect that is inevitable in small samples. There was also considerable zero drift (fig. 5*c*) due to variation in coil temperature.

Figure 5 illustrates the recordings of:

a) Cold calibration on 5-mm deep notch
b) Test at about 900 °C on 2 mm and 7 mm deep notches
c) Hot tests on 5 mm deep notch. Nine recordings of measurements made in the 980-800 °C temperature range are shown. Lift-off was 16 mm in the first five, about 14 mm in the sixth and seventh, and about 18 mm in the eighth and ninth.

It ensues from examination of the data that:

- sensitivity of the hot detection system is reasonable, loss of signal amplitude compared with the cold measurements being around 8±2 db, which does not detract from the validity of hot testing
- with further studies and refinements it should be possible to improve on the present minimum detectable defect (2 mm).

CONCLUSIONS

The «electromagnetic resonance» system allows detection of surface defects in hot slabs with sufficient sensitivity at probe lift-off of between 16 mm and 22 mm, which allows insertion of an suitable heat protection system.

The following conclusions can be drawn from laboratory tests of the prototype probe:

- the air-cooling system provides proper heat protection for the resonant circuit.
- Hot testing of samples with artificial defects (2, 5 and 7 mm notches about 50 mm long) proves the method to be basically sound, enabling such defects to be detected at temperatures around 1000 °C

– Defect depth can be measured correctly by maintaining lift-off within a tolerance of ± 1 mm
– As lift-off is increased there is gradual loss of in-information on defect depth but this can still be detected up to a maximum distance of 22 mm.

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WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

FRENCH INDUSTRY AID FUND ELIMINATED ON 1 AUGUST

'FIM' Funds Redistributed

Paris LE MONDE in French 31 Jul 86 p 20

[Article by F. Gr.: For related article, see JPRS WEST EUROPE REPORT No 86-052 dated 29 May 86 p 9]

[Text] Minister of Economy, Finance and Privatization Edouard Balladur and Minister of Industry, Posts, Telecommunications and Tourism Alain Madelin submitted a report to the Council of Ministers on Wednesday, 30 July, on the system of aid to industry, after obtaining the report Minister Madelin had requested of Roger Martin, the former PDG [president and director general] of Saint-Gobain.

The government wants to look in depth into the system of aid to industry as a whole. In 1986, 86.2 billion francs were spent by the public authorities, including 54 billion for industry as such and 22 billion for jobs. The government has decided on gradual reduction, if not elimination, of certain types of aid.

Along with this, reductions in financial charges, taxes in particular, will be allowed, for small and average enterprises in particular. Minister Madelin confirmed that the Industrial Modernization Fund (FIM), which was established in 1983 to make loans to enterprises, will be eliminated as of 1 August (LE MONDE, 17 July). This will make available 7 billion francs collected by the CODEVI and administered by the Deposit Fund.

This money, to which will be added 5 billion francs in loans, will be returned to the banks, which will then be able to grant loans to the PME at a lower rate--8.25 percent interest instead of the present 8.75 percent. "Too large a part of the public resources has been utilized to date to the benefit of the large enterprises," the minister said.

The Minister of Industry is being told that the amount of aid to enterprises, which has increased by 240 percent since 1980, will be reduced by 11 billion, to a total of 53.5 billion francs for 1987. Moreover, according to Minister Madelin, it is necessary to make use of market mechanisms again to finance enterprises. It was therefore decided, in an agreement with Minister

Balladur, to eliminate the FDES loans, which were not included in the budget, and which have totaled 10 billion francs annually for the past 3 years.

Effects on Small Business, Research

Paris LE MONDE in French 17 Jul 86 p 22

[Article by Claire Blandin]

[Excerpt] The elimination of the FIM, it is said, will be one of the main consequences of the report delivered by the former president of Saint-Gobain, Roger Martin, to whom the government assigned the task of making a study of the French system of aid to enterprises.

This report, submitted more than 15 days ago, urged the elimination of the FIM, among other things. This was a suggestion upon which the Rue de Rivoli was quick to seize. In fact, the technocrats in the treasury never fully accepted the creation of the FIM at the end of 1983 by Laurent Fabius, who was then minister of industry. He had succeeded in equipping his ministry with an autonomous resource, finally free of the tutelage of the treasury. This resource comes out of what is collected by the Industrial Development Account (CODEVI), which was created at the same time as the FIM and operates through various financial networks (banks, savings funds, treasury accounts). A part of what is collected is centralized in the Deposit Fund (47.5 percent for the banks since March of 1985), which itself pays out the sums necessary for the financing of the technological participation loans of the FIM.

Thanks to the relatively low cost of collection (CODEVI has been compensated at 4.5 percent since May, as compared to 6 percent earlier), these loans offer rather low interest rates (reduced from 8.75 percent to 8.25 percent in June).

The FIM was initially established to finance investments for modernization, with priority established for the PME. But as time went on, it fell victim to all of the problems characteristic of the French aid system. Monopolized by the large enterprises, which accounted for more than half of the loans distributed, it was also tapped by the sectors experiencing difficulty, such as the automotive industry. For example, in 1984 and 1985, Peugeot and Renault received about 1 billion francs each to finance their investments. To compound the misfortune, the authorities in Brussels recently looked into the file and accused the FIM of deviationism. They had agreed to this aid procedure under very specific conditions (reduction of production capacity, reduction of regional disparities). In view of the fact that in many cases (Perrier, European Brewery, Peugeot, Renault, Pechiney) these conditions have not been met, the European Commission is challenging the activities of the FIM (LE MONDE, 14 March 1986). At the time of the advent of the liberal Minister Madelin and his stated desire to revise the system of aid to enterprises, the existence of the FIM was hanging by a thread. The Martin report dealt it the final blow.

Apart from the sacrifice to the prevailing liberalism which it represents, the elimination of the FIM will have another advantage. The sums returned to it will in fact be redirected toward the PME. Thus one of the problems Minister

Balladur faces will be in part resolved--that of making loans available to the PME at privileged rates, unable as they are to benefit from the general rate reduction because they do not have access to the financial market. It is the banks which will implement the reorientation of these sums. They have experience in this connection since they are already making bank loans to enterprises (PBE) out of a part of the CODEVI resources they hold at rates (since last May) of 7.75 percent for loans of less than 7 years and 8 percent for longer periods.

They will in the future retain a larger part of what the CODEVI collects, which will not therefore go to the Deposit Fund any longer, for the development of these loans. This development will of course remain a function of the volume of funds collected by the CODEVI. After being blocked for a period due to the establishment of the fund, these sums consolidated somewhat (72.1 billion francs collected as of the end of 1985, and a provisional figure of 74.3 for the end of May 1986), limiting their use to an extent.

The elimination of the FIM and the redirection of the resulting resources will not, however, put an end to the criticisms of the system of loans at privileged rates--in particular, that pointing out that the extension of these loans has the effect of driving the average cost of credit up.

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WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

FRANCE'S PROPOSED 1987 RESEARCH BUDGET UP 5.8 PERCENT

Paris LE MONDE in French 3-4 Aug 86 p 8

[Text] The draft research budget for 1987, reduced solely to the portion allocated under this heading to the Ministry of Scientific Research and Higher Education, is expected to be up 5.8 percent in current francs (3 percent in constant francs) over the 1986 budget. The initial 1986 budget called for 27.2 billion francs, of which 3.2 were eliminated last April.

It is believed at the ministry that this is a positive development, in view of the government's desire to reduce public expenditures. It is thought there that the 1986 budget, in its initial version, was unrealistic, with a number of inevitable expenses having been seriously underestimated. With or without a change in the majority, the thinking is that a budget reduction will be imposed during the course of the year, as was the case in 1982 and 1983. It is therefore believed that the only pertinent comparisons would be those with the corrected 1986 budget, with the presumption that the credit approved for 1987 will not also suffer cuts during the year.

Research, like the majority of the other sectors, will have a personnel reduction of 1.5 percent. Minister Alain Devaquet has chosen to effect this reduction by giving priority to the hiring of researchers, such that other personnel will bear the brunt of the dismissals. Thus there will be an increase in the number of researchers (up 280) and a reduction (down 500) in the number of engineers, technicians and administrative employees.

The distribution by bodies favors the public institutions of a scientific and technical nature (CNRS, INRA, INSERM, ORSTOM), which are receiving an average increase in credit of 9 percent. The program authorizations of these bodies had been cut by 10 percent in April. For public establishments of an industrial nature (CEA, CNES, IFREMER, CIRAD), whose program authorizations were not affected by the spring cuts, the increases are much smaller.

The CEA, which has a civilian budget divided between the Ministry of Research and the Ministry of Industry, is to receive the same sum overall. The French Sea Institute (IFREMER), which had undertaken heavy expenses, will see its program authorizations cut somewhat next year. Such authorizations will be up slightly (1 percent) for the Center for International Cooperation in Agronomical Research for Development (CIRAD). The CNES will receive an

increase of at least 3.5 percent. Its budget has not yet been definitively established, pending decisions to be made soon on space policy.

The Research and Technology Fund (FRT), which is the main tool of ministerial action, was very sharply cut by the corrective finance law (down 40 percent). In 1987 it will have 715 million francs, as compared to 530 million in 1986. This fund was viewed askance by the ministerial delegate in charge of the budget, and Mr Devaquet had considerable difficulty persuading his interlocutors of the need for the FRT. Its activities will be more oriented toward industrial research, which is expected to receive 40 to 45 percent of the credit, as compared to 30 percent earlier.

The minister did not have the same success with the National Agency for the Development of Research (ANVAR), which will see a 30 percent credit cut. His colleagues believe that this body had somewhat neglected its assigned task, the financing of predevelopment (from the concept to the prototype) through the allocation of credit which would more normally come from bank loans. The French Agency for the Mastery of Energy, another victim, will only have 130 million francs, and is thus losing more than one third of its credit allocation.

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WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

HIGH-LEVEL FRENCH SCIENCE POLICY GROUP ON 1987 R&D BUDGET

Paris LE MONDE in French 7 Aug 86 p 8

[Article by Maurice Arvonny: "The Budget Bill Sacrifices Industrial Research"]

[Text] The Conseil Superieur de la Recherche et de la Technologie (CSRT) (High Council of Research and Technology)--known as the "Committee of Wise Men"--is the highest authority on scientific policy. At regular intervals, under the directorship of the supervising minister, currently Mr Alain Devaquet--it investigates governmental action, and particularly the drafting of the Budget Civil de Recherche et Developpement (BCDR) (Civil Research and Development Budget). During such a meeting on last 3 July, CSRT expressed an opinion that it had not previously made public, as it was waiting to do so until the budget bill was finalized. Since one part has already been made public (LE MONDE 3-4 August), the part included under the ministry of research and higher education, Mr Frances Kourilsky, vice president of CSRT, has decided that certain comments can be made.

The first is that the available information is incomplete, and that the amount of increase of 5.8 percent Mr Devaquet obtained for the funds coming under the supervision of his ministry do not extend to the entire budget. The minister evaluates only the research funds for which his ministry is responsible, whereas his predecessors were responsible for the entire budget, which was subsequently divided among the different ministries responsible for its execution. This new process does not ensure that the balance between basic research, applied research and large technological development programs will be maintained. It sends an arbitration to the ministry of finance for which they have no particular expertise. Moreover, in Mr Devaquet's cabinet, it is acknowledged that the requests coming from other ministries were less well-received at the Conseil d'Etat (Council of State), and that the amount of increase of the BCDR should be lower than the aforementioned 5.8 percent.

Therefore, after comparing expenditures over several years, the Council has decided that, after the significant cutbacks in funds made at the end of April, an increase of at least 6 percent would be needed in the cut budget so that the level in 1987 would be the same as the 1985 level. It is clear that this will not occur. We will be even further away from the three-year plan adopted in 1985 by the Parliament, which promised annual increases of 4 percent in volume and 1400 new jobs per year.

Insufficient Incentives

A second observation is that the budget bill paradoxically sacrifices industrial research. In 1985, the Fonds de la Recherche et de la Technologie (FRT) (Research and Technology Fund); and means for direct intervention by the ministry, had 1200 million francs available. At the request of CSRT, it decided that half of this amount would go to industry, which has been done. In the initial 1986 budget, FRT's allocation was approximately the same; however, it had 530 million francs restored by the financial rectification law. In the budget bill for 1987, FRT should have 750 million francs available of which 40 to 45 percent will go to industry, resulting in a sum much lower than the one for 1985.

The National Agency for Research Development has seen its budgets greatly diminished. Thus the funds it distributes are, according to Mr Kourilsky, "the only means of encouraging PME-PMIs to do research." A large part of the appropriation for the French Agency for Energy Management, which has been cut by a large amount, will go to industry; the same is true for the electronics sector.

The policy expressed by the government is to reduce direct support while decreasing responsibilities and increasing fiscal incentives, although CSRT is not at all convinced that such measures will result in industrial research growth--past experience demonstrates that such measures have had no effect on certain branches. Mr Kourilsky fears that support given to businesses experiencing difficulties has been confused with encouraging research in poorly-prepared sectors (such as the food industry) and in those sectors in which technology is "expanding."

The third characteristic of the budget bill is the reduction of jobs, which is a first for France. Mr Devaquet has "judiciously chosen" to implement this reduction in jobs for engineers, technical personnel and administrators, and to maintain jobs for researchers, although this is the lesser of two evils. France is far behind its competitors. In the private and public sectors, there are 3.7 researchers per 1,000 people in the work force, as compared to 4.7 in West Germany, 6.2 in the United States, and 6.9 in Japan. The imbalance is even greater if only the industrial sector is considered.

Finally, in the opinion of the vice president of CSRT, the minister has partially rectified the April cutbacks, and his budget retains a relative priority over all the government budgets. However, this will not prevent the overall research effort from decreasing in 1986 and 1987, in stark contrast with the increase which was begun in 1979 and augmented starting in 1981. CSRT has determined that the budget cutbacks for 1986, which Mr Kourilsky qualified as being "too rapid and poorly thought out," and which are in no way comparable to those made in 1982 and 1983, will have caused a sudden break in the previous development process. There is a clear change in policy, and CSRT would like the government to clarify and explain its vision of what research in France should be.

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WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

FRANCE RELEASES DETAILS ON 1987 R&D BUDGET

Overall Increase of 0.6 Percent

Paris LES ECHOS in French 20 Aug 86 p 5

[Text] The final decisions on the research budget have at last been released and they underscore the austerity policy for which the Chirac government has opted. Accordingly, the overall 1987 budget--which does not include military research expenditures but does include those related to development and large-scale programs--will consist of 39,106 billion francs, up 0.6 percent compared to 1985. However, an additional sum of several hundred million francs may be granted to new space programs.

There is no denying, however, that the screws are being tightened compared to the initial 1986 finances law, in which the civil research and development budget (CRDB) was set at 42,083 billion. This was slashed by about three billion, however, when the budgetary collective, described by Alain Devaquet's ministry as a "return to economic reality," was established.

Furthermore, the ministry also pointed out that the very structure of the budget has changed and that if one considers only the actual ministry budget, the latter has risen 5.8 percent, to 20.3 billion (4 August "Les Echos"). If the National Center for Space Studies (NCSS) is added, the figure is 25.3 billion.

In addition, the new format no longer includes either the sums allocated to the Research Applications Agency (RAA), which now falls under the Ministry of Industry, or the endowment for the electronics product line (around 1 billion in 1986).

There were no surprizes in the area of employment, which will show a net decrease of 0.5 percent, with researchers making out better than the ETA (engineers, technicians and administrative personnel). The total research staff in public institutions will therefore increase from 18,550 to 18,830. At the NSRC, the net number of positions created will be 203, but if normal turnover is taken into account, the Center may hire more than 400 people. At NARI, 40 positions will be made available, 35 at NIHMR.

The vice-president of the Research and Technology Superior Council, Francois Kourilsky, yesterday stated that this policy was "a clear break with past years." In his opinion, this break signals "the danger of a decline in the

country's overall research effort," all the more so as this is the first time that positions have been eliminated, he stated, adding that he was concerned about the decrease in funds for industrial research.

Industrial R&D Cut

Paris LE MONDE in French 21 Aug 86 pp 1,15

[Article by Elisabeth Gordon: "Research Budget Sacrifices Aid to Industry"]

[Text] In an atmosphere of budgetary restrictions, the minister of research and higher education, Mr Alain Devaquet, has succeeded in his ambition to "save the furniture." His department's budget will increase by 0.6 percent in 1987 compared to the previous year. However, 1987 marks a clear break with the policy of high growth pursued for four years as well as a change in priorities: industrial research is sacrificed in favor of basic research.

Basic research has on the whole been left intact, undoubtedly an expression of the preferences of Mr Devaquet, a theoretical chemist. However, the latter was forced, in an unprecedented move, to eliminate engineer, technician and administrative staff positions in establishments under his direction to conform to government directives.

Industrial research remains the area hardest hit by the effects of austerity. Only the tax-research loan, a form of fiscal aid to companies the amount of which is not yet known, is expected to be renewed, even increased. But direct aid to companies, like that distributed by the NRAA, will clearly decline, a measure from which small and medium business and industry may be the first to suffer.

These are the essential elements of the civil research and development budget (CRDB) made public by Mr Devaquet's staff. The budget should amount to 39,083 million francs (FF), or slightly more than in 1985 (38,888 FF). This implies an overall growth rate of 0.6 percent compared to 1986 and, if adjusted for inflation, of minus 1.4 percent in fixed francs.

This means that the large organizations in particular, which fall under the direct jurisdiction of Mr Devaquet, should see an increase in their funding (3-4 August, Le Monde), while research establishments and agencies which are also listed in the CRDB but which fall under other ministries will see a very slight increase or drop in theirs.

In analyzing developments in comparison to last year, it must be pointed out that the 1986 budget was trimmed by some 3.2 billion francs last April by budget ministry personnel. Initially projected sums "had been overestimated," in the opinion of Mr Devaquet's entourage. The minister believes that the only significant comparisons that can be made are with the "amended" 1986 budget.

Thus, funding to be channeled to public scientific and technological establishments (NSRC, NARI, NIHMR . .) (see table) will jump significantly (nearly 10 percent on the average). This somewhat compensates for the cuts these organizations experienced in the spring. On the other hand, public industrial and commercial

establishments (AEC, NCSS, FIRESEA . . .)--little affected by April's annulments--will experience slighter increases, and even some decreases. The NCSS could, however, receive a supplement of several hundred million francs if new European space programs (Hermes, Columbus) are undertaken in 1987.

As for the agencies, they are not exactly spoiled. This is true of NRAA, which was hit this year with a hefty funding amendment and which "should realign itself and increase its own revenues." It is especially true of FECA, which is expected to devote itself to "long-term research." Finally, funding allocated to the electronics product line--in the form of a capital endowment for this sector's industry--should drop from 1 billion francs in 1986 to 500 million francs in 1987. It is true, as is stressed by the ministry, that "this is not true research." Nevertheless, overall, industrial research as a whole is being affected, especially since Research and Technology Fund incentive loans (40 to 45 percent of which are to be channeled into industrial research compared to 50 percent previously) were severely slashed by the amending finance law (down 40 percent).

An Overall Negative Balance

Although the April 30 government directive requested a 1.5 percent decrease in personnel in public administration and establishments, creation of positions is down "only" 0.5 percent in organizations under the direction of the Ministry of Research. The minister's entourage further states that it has even been possible "to create a net number of 280 research positions" which will be used primarily to hire young scientists. Thus, the number of researcher positions is slightly on the rise (up 1.47 percent) while engineer, technician and administrative personnel positions (ETA) show a proportional drop (down 1.54 percent). At the NSRC for example, 203 researcher jobs will be created (but some 320 ETA jobs eliminated), along with 35 at NIHMR and 40 at NARI.

All the same, taking into account the April directive, some 900 researcher and ETA positions had to be cut. Mr Devaquet managed to create new ones a few months later, but the overall balance is still negative (down 373).

"It is the first time in the history of French post-war research that postions have been eliminated," Mr Francois Kourilsky emphasized. The vice-president of the Research and Technology Superior Council (RTSC)--a "group of experts" that advises the minister on his policy orientation--is also worried about the elimination of ETA positions, "which could seriously impair the functioning of laboratories."

Moreover, Mr Kourilsky's judgement of the budget bill as a whole is rather severe. "The years 1986 and 1987," he told us, "mark a disquieting break in research and development policy compared to previous years." It is true that the budget bill shows evidence of "the research minister's willingness to correct certain effects of the 1986 budget annulments," Mr Kourilsky notes, but he points to "a wavering in the overall French research and development effort." According to him, basic research is "insufficiently supported" and he expresses "concern" about the future of the policy to restimulate industrial research.

1987 Budget for Research Organizations

(Operating Expenses + Program Authorizations)

	1987 Budget (in million of francs)	Percent of change compared to 1986 (amended budget)
NSRC (National Scientic Research Center)	8,812	+10
NIHMR (National Institute of Health and Medical Research)	1,576	+14
NARI (National Agronomical Research Institute)	2,196	+ 8.9
FISRJD (French Institute for Scientific Research on Joint Development)	693	+ 9
NCSS (National Center for Space Studies)	5,022	+ 3.6
AEC (Atomic Energy Commission)	6,730	- 4.3
FIRESEA (French Institute for the Research and Exploitation of the Seas)	777	- 4.3
FECA (French Energy Control Agency)	163	-36
NRAA (National Research Applications Agency)	650	+10

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WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

'INSUFFICIENT' FUNDS ALLOCATED TO ITALIAN R&D

'Behind Other Western Countries'

Rome IL MESSAGGERO in Italian 17 Jul 86 p 21

/Article by Elio Pagnotta/

/Text/ Does our country really believe in "high tech" and the possibilities of research? From the results of Istat's /Central Statistics Institute/ annual survey of scientific research in Italy it would really seem so. According to the first estimates, about 10,211,000,000,000 will be spent on research, a record figure for Italy, which is exceeding 10 trillion lire for the first time. But that figure corresponds to a growth rate of only 9.3 percent from 1984, and it is accordingly the lowest increase of the 1980's, especially as it is expressed in purely monetary terms.

In fact, since inflation will remain around 6 percent in 1986 it can be estimated that the real increase in the outlay on scientific research will be 4 percentage points less. To make a comparison with the past it is sufficient to recall that in 1985 the outlay on research was over 9.3 trillion lire, with a nominal increase of 27.6 percent and a real one approximately equal to 19 percent (Inflation was 8.6 percent last year), that is nearly five times greater than the one that is to be expected at the end of 1986, and that too while the other countries of the industrialized West are sharpening the tools of the new technologies.

Furthermore Italy's completed effort to improve its positions appears distinctly reproportioned in terms of percentage of the GNP (PIL) as well. In fact in 1985 some 1.36 percent of the GNP was spent on research, while in 1986 that percentage could quite possibly go down instead of up (on the assumption that the GNP will increase about 10 percent at current prices), a situation to minimal or no "advantage" that would leave Italy behind the western countries. It is not necessary to go outside EEC to see that we are not among the first even in Europe, to say nothing of giants like the United States and Japan, where just one industry in the photography sector has invested trillions in research. France, for example, was already spending 1.43 percent of its GNP on research in 1983 (Eurostat figures), and England was spending 1.35 percent. And those are percentages of stronger GNP's than the Italian one.

What is more, the greater part of the costs of scientific research will be borne as in the past by the enterprises, which will ultimately contribute nearly 5,725,000,000,000, or more than half the total (56.1 percent), while the public sector will spend 4,487,000,000,000 and will also log an increase (+6.3 percent) less than that of the enterprises (+11.8 percent).

Minister Granelli on CNR's Fund Allocation

Milan FATTI E NOTIZIE in Italian 4 May 86 pp 4-5

/Interview with Minister for Coordination of Scientific and Technological Research Luigi Granelli by Fabio Magrino/

/Text/ The Grand Trade Fair in April was attended by the Pirelli Group with a stand of its own on the premises of the Research Exhibition.

The event was concluded with a press conference attended by Minister for Coordination of Scientific and Technological Research Hon Luigi Granelli and Chairman of the CNR /National Research Council/ Prof Luigi Rossi Bernardi.

FATTI E NOTIZIE asked Minister Granelli some questions about the future of Italian research and Pirelli's contribution to innovation in the telecommunications sector.

MAGRINO: Mr Minister, on 19 April at the Milan Trade Fair you announced a package of 10 new "definitive plans" of the CNR's with a heavy public investment in basic and applied research for the next 5 years. What are the objectives of this program, and what are the possibilities of collaboration with private industry?

GRANELLI: An outlay of about 500 billion lire in 5 years is estimated for the projects you mention, which are appropriately defined as a "new generation." They are programs expressly planned for advanced technologies in the fields most vital to Italy.

MAGRINO: Could you mention some of them?

GRANELLI: Certainly. There are telecommunications, robotics, electronic technologies, new materials and fine chemistry. The purpose is to expand collaboration with industry as far as possible in order to implement the programs, as well as training of specialists through scholarships. Therefore I repeat, the most important objective of collaboration with industry lies in the high strategic quality of the research.

MAGRINO: How and with what prospects can the industries be involved?

GRANELLI: Perhaps I should clear the field of possible misunderstandings right away. All right, the industries that wish to collaborate cannot imagine eliminating the setbacks from the definitive plans of a new generation in the short term. That is an action that requires "great breathing space" and quality collaboration in order to lend these definitive plans a very different character from the past one even from the standpoint of production and to enable us to accept the international challenge in the vast field of technological innovation.

MAGRINO: Do you think enough public financial resources are allocated to research in Italy today?

GRANELLI: Absolutely not. The allocations for research in the course of 5 years must be doubled. The proportion of the GNP spent on research is too low. The last financial law is inadequate in that respect. But the international economic situation, which suggests greater flexibility in opening state accounts and in allocating resources, may enable us to recover this year what we did not obtain last year. In any case, to go on with the subject of the CNR's definitive plans, 500 billion is no negligible sum. At least it is enough to improve Italy's presence in the field of research.

MAGRINO: I have a specific question for you. In the telecommunications sector, for example, what are the research priorities for innovating applications and what part can big industry play?

GRANELLI: Telecommunications is a sector of vital importance to the country's future.

MAGRINO: I seem to recall that you spoke of a huge investment of more than 100 trillion.

GRANELLI: Yes, you are right, over 100 trillion in 10 years. Of course when the investments are that heavy considerable support is expected in the way of scientific research, innovation and investments in development. The CIPE /Interministerial Committee on Economic Planning/ is discussing the idea of instituting a program to coordinate all research on telecommunications, such as the effective research projects other than the CNR's finalized projects, which are awarding national research contracts, the experiments that the law for the South can make in southern areas, and the same projects for industry, which can be financed through the "46." In short, there is a series of initiatives with a specific bearing on telecommunications.

MAGRINO: What contribution can the Pirelli Group make to Italy's technological progress in telecommunications?

GRANELLI: Clearly the contribution of a group like the Pirelli one, with a vast international prestige, an enormous presence on the market, and its own technology in the fields of highly sophisticated cables and optical fibers and in many other fields, has a particular place of its own in this picture.

I think it is just a matter of better coordination of all the group's activities with the programs in the public interest that are being gradually developed. I know very well that public research, by its nature, goes beyond the immediate industrial interest. The industries themselves cannot imagine doing research on their market demands (which would not prepare for the future), but even with these distinctions there is a fertile field for extensive collaboration between the state, which intends to accomplish the strategic objectives important to telecommunications, and the largest national group in the sector. Pirelli's collaboration can help to accomplish results satisfactory to all.

MAGRINO: Should Italy participate in the extensive European research programs like the Eureka program for example?

GRANELLI: Not only does Italy participate in the extensive European projects, but it is also one of the countries far-sightedly proposing a still broader policy in this field. We have been urging for some time at least a doubling of the financial resources that the EEC allocates to research and development. As for Eureka, Italy has taken a prominent position in supporting the appointment of a "secretary for coordination" and making bold proposals for financing research on the European level, exacting selection of the projects, and incentives on the national level, so that all Europe will agree to overcome the "gap" that separates it from the United States and Japan.

MAGRINO: It seems to me you are hoping for a kind of "new presence" of Italy among the industrialized countries.

GRANELLI: That is so, in a sense. Today there is not only an Italy "allowed to participate in another's initiatives." There is a country in a very advanced stage of transformation proposing ambitious goals and more challenging programs to its European partners. Then we are to decide upon participation in the various European projects, including Eureka, in proportion to our technological potentials, financial resources, and the actual potentials of our industries, the CNR, and our universities. There are sound reasons for considering this participation important, and it is being constantly expanded, from the telecommunications sector (Esprit, Brite), to the biotechnologies and other fields.

MAGRINO: What do you think of the Pirelli Industries' undertaking to create an "Integrated Technological Center" in the Milanese area of La Bicocca?

GRANELLI: You are bringing up problems with which I have been concerned for years and they remind me of interesting experiences on the Milan Communal Council. If you are thinking of the "cabled" Milan of the future, there is no doubt that a technological center in the middle of the city (at one and the same time the coordinating point for all information services and headquarters for study and in-depth investigation of the most advanced strategies) is very useful for the readjustment of the metropolis. My opinion is favorable as to the intended purpose, as far as we know, of building the Integrated Technological Center in the area of La Bicocca. But I must add that I do not think this initiative can claim to be exclusive or to solve any broader regional problem. Well utilized scientific parks, technological centers and connections between the university and industry can also spring up outside the city in areas in the region where there are significant industrial activities, as a "whole" to be seen freed of useless competition and partiality.

The local authorities and especially Lombardy Region must make plans with ample breathing space, so that all these advanced initiatives will be neither duplicated nor in useless competition but will be an enrichment of the Milanese and Lombard region and of the services that all the post-industrial societies will have instituted by that time.

MAGRINO: The big private firms, including Pirelli, have always played an important part in the training of young researchers. What intiatives and new forms of collaboration with the public research institutes and agencies could be started by encouraging a greater effort in this respect on the part of the private firms?

GRANELLI: I would say just two things, namely scholarships, or rather possible grants, to help graduates participate in the national research programs and acquire international experience enabling our researchers to return to Italy with a more advanced preparation; and agreements and accords between the industries and the universities, the CNR and all the research activities, not in order to "bend" them to the industries' immediate interests, but to bring about a synergy among scientific research, personnel training and industrial development, in short a broad field of collaboration which, however, must be focused upon personnel training, increasing the number of researchers, and development and application of their capacities.

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WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

FRANCE'S MATRA: RECENT HISTORY OF SETBACKS ANALYZED

Paris L'USINE NOUVELLE in French 5 Jun 86 pp 60-63, 65-67

[Article by Claude Amalric: "Matra, Industrial Fallback"]

[Text] Jean-Luc Lagardere nurtured great industrial ambitions for Matra. Today, he is organizing its fallback and refocusing his company on a smaller number of activities. Diversification has now become the goal of Hachette, which is chaired by Matra's boss.

The amazing Matra: overly admired before 1980, and too quickly burned up afterwards. A symbol of advanced technology's success, the group chaired by Mr Lagardere became as it was being formed, the very example of chaotic diversification: from space to publishing, from watches to machine-tools and to automobiles. As the poor results of these disparate, hastily acquired subsidiaries accumulated--the initial nucleus of military and space activities remaining strong--the oracles started their death knell: if Matra persists in dissipating its strength into such diverse and mostly unprofitable industries, it is courting disaster.

Over the years, time has proven them right. On total revenues of 13.7 billion francs in 1984, the Matra parent company sectors--military and space--brought in 970 million, which the subsidiaries immediately absorbed almost entirely with deficits of 926 million! In fact, without the legal practice of deficit carry-back, 215.3 million would have had to be subtracted from the 68 million of the consolidated results: for the first time in its history, Matra would have been in the red.

And 1985 did not appear to be much better. "It will be the last year of the restructuring started in 1983. The sectors incapable of development within the group cannot be retained," warned Mr Lagardere once more a year ago. How far would he go? Worried, the market reflected its dismay by dropping the stock from 2000 to about 1400 francs in six months.

Early 1986 heightened the pessimism of the analysts who predicted a delay in Matra's recovery to 1988. Added to this, the company suffered new blows: the Eutelsat television and telecommunication satellites are to be built by Aerospatiale and its associates, with Matra losing a market for which it had secured the first generation equipment (ECS) in 1977.

At the same time, the other key sector--the military--is also suffering a setback in favor of Aerospatiale, whose Aster ground-air missile will very probably be picked over the Samat proposed by Matra for the three branches of the armed forces. Everything concurs to heighten the unease gathering around Matra, which had adopted prestige and excellence as keys to force open locks whose complexity they never really perceived. Such was the mood barely three months ago.

At the beginning of May, the skies cleared up. Not only did Matra report profits in 1985 without carry-backs, but these profits exceeded the highest estimates of the most optimistic analyses. This result is due to the recovery of its subsidiaries. With revenues of 14.9 million francs, the group obtained 113 million of consolidated net. Madness reigned on the stock exchange, where Matra's stock, which had already gone from 1470 to 2300 francs after the group's denationalization had been announced, continued to rise beyond 2600 francs. In this new context, the planned takeover of TF1, which would have certainly been misunderstood several months earlier, becomes an additional gold star.

Progress interrupted by such convulsions can be expected to surprise both business and industry, as well as the consumer public, which Matra had until now addressed to establish its image.

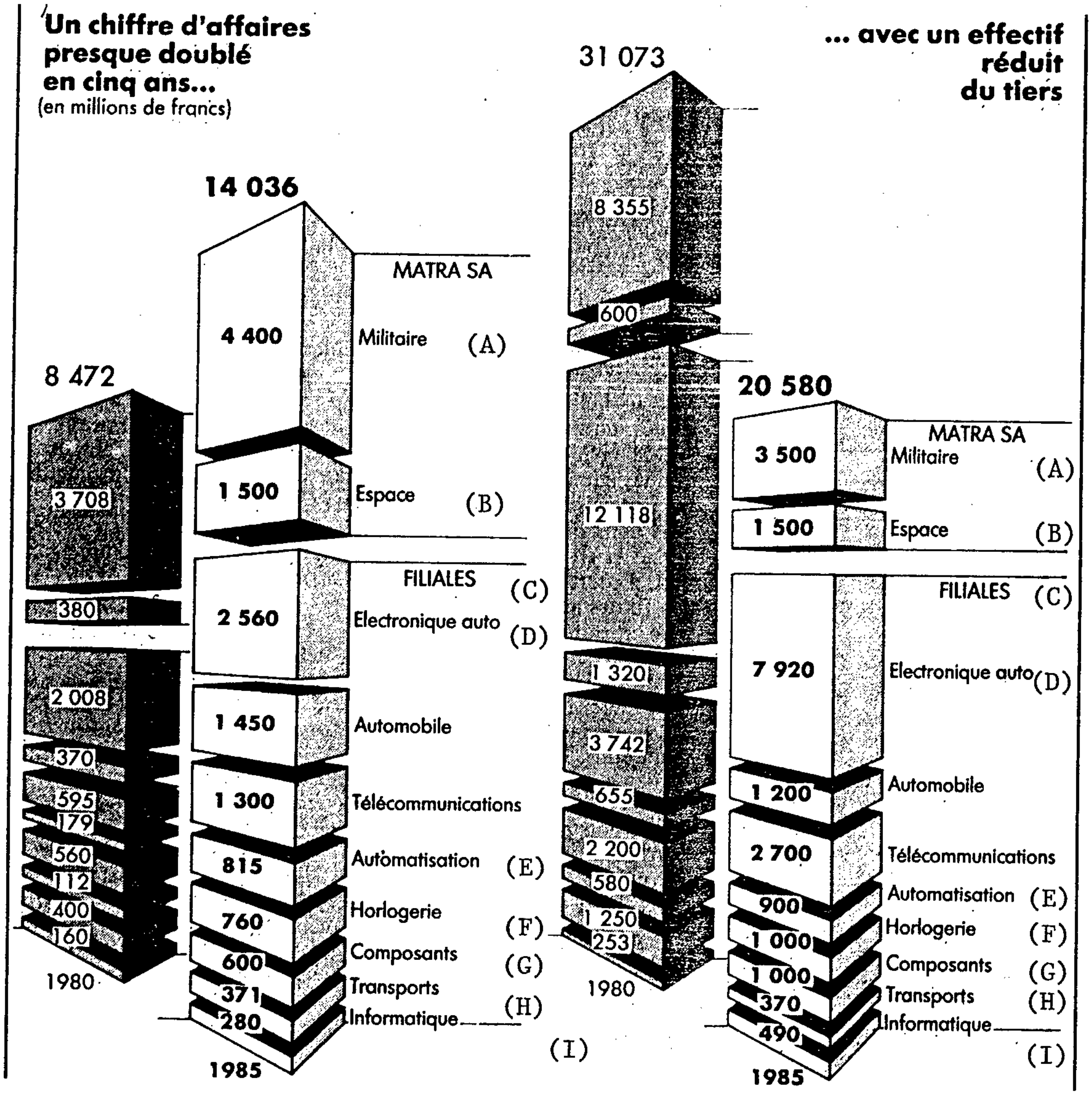
Its image? Which image? Pursuing all these goals, Matra's image has become too fragmented to remain effective. Floodlighted everywhere, it has lost the highlights derived from shadows. Without a precise image, without an obvious orientation, many are asking where Matra is heading.

The answer requires no wisdom. All we have to do is review Mr Lagardere's statements since 1980, and especially during that period, when the group was at its full strength; it is all there. In all fairness, he has done nothing more than carry out what he said at the time.

Therefore, when Mr Lagardere, who is also Hachette's chairman, proposes to acquire TF1, we cannot be surprised. "At Matra, communications in several years will be as important as the military," he assured us on 12 December 1980, after gaining control of Hachette. "All forms of communication; as well as television." To the often voiced observations about the apparent lack of synergy among the program activities, book publishing, and the already assembled and already demanding industrial complex, Mr Lagardere always responded with a concept of technological humanism worthy of Japanese philosophy: "Between satellites and manuscripts lies an unbroken chain. And to develop it, we are fortunate to have at our disposal French culture, our best brand image." That is certainly true, but what ambition!

How can the leader of Matra, an enterprise with 28,000 employees, which is now undergoing another metamorphosis, expect to enter with Hachette into the TF1 adventure? Beyond the great principles and the means (at least 2 billion), one thing is evident: the taste for picking up a challenge is a matter of faith.

In five years, almost twice the revenues (in million francs) with one-third less personnel



Key: (A) Military (B) Space
(C) Subsidiaries (D) Automobile electronics
(E) Automation (F) Watch making
(G) Components (H) Transportation
(I) Computers

Unlike other groups where risk taking is an ill necessary for survival, at Matra risk is already a motivation in itself, which together with a passion for technology and the certainty of being the best, yields a strategy: "In some areas we are the leader. The use of these kernels to plant in other

technologies brings about a diversification which makes the company less vulnerable." This statement dates back to October 1980; it summarizes very well what had just been done, and will be done again after the refocusing that is taking place at this time.

For this unfortunate episode in Matra's expansion, an explanation for what has been considered as hesitation is found in Matra's own culture. "It is necessary for some activities to be protected and maintained even if they are not profitable at first," declared Matra's CEO at the end of 1980, adding that "a group's roots are not its most visible feature."

To this we can add the restrictive shading mentioned earlier about "the sectors which do not find in the group the possibility for their development." Four years later, it represents the only acknowledgement that a judgement error may have slipped into the doctrine's implementation.

Mistakes are easily spotted after the fact, but not as easily as is generally claimed. This electronic company's diversification into automobiles is a good example. "Who better than Matra can build in France the frugal 1990 car loaded with electronics?" asked Mr Lagardere in 1980. Created in 1973, this activity was already old: Matra had produced 77,000 cars in seven years and planned to build 24,000 in 1983 thanks to the association it had just formed for distribution with PSA after the Chrysler failure. The production plan was to bring the branch's personnel to 2000 people, with a calculated profitability to reach 5 percent in 1983.

"Associates Wanted." In Japan? Why Not

Now for some painful figures: the branch lost 106 million francs in 1983, and 140 million the following year. The fact is that it took Mr Lagardere's courage and his taste for business to proceed as he did in such a precarious context. His fine optimism was sorely needed! Was it to be curtains? No! Because this time it really came to pass! Despite Matra's associate, Renault, the Espace is selling very well, exceeding the capabilities of the Romorantin plant, limited to 80 cars per day. Matra automobile could thus turn a profit in 1986!

Henceforth, unless another product comes in time to take over from Espace, the fate of the branch remains precarious. "Associates wanted," says Matra. In Japan? Why not. And so the Matra-ites are looking.

If, once the agreement with Fiat is finally authorized, the automobile electronics branch experiences an outcome better than its beginnings, it will further illustrate Matra's mastery of the art of converting a failure into success.

Matra created this activity in 1979 by acquiring Jaeger, with a total of 13,000 employees in 19 subsidiaries, and Solex, with 2900 people in seven subsidiaries; with CIF's 1300 employees, this comes to 17,000 people in a so-called good sector, so-called because automobile electronics consists more

of words than deeds, especially in France! But the French automobile industry was the first in Europe; to retain its position it had to veer toward electronics. In that case Matra would have won! But the French automobile industry unfortunately lost its standing, and Matra remained alone with a huge tooling load to modernize: an absolute nightmare.

Despite personnel reductions, the losses were getting heavier: 120, 172, 140 million in 1984! Yet where automobile electronics is concerned, "we continue to believe in it, but we haven't reached a critical size," assured Pierre Prieux, director of this activity. A partner was therefore necessary "who will not have a blocking minority," he insisted. Fiat had similar difficulties with its specialized subsidiaries, and was therefore interested. But the French customers who were absorbing current production were loath to accept the partitioning of Jaeger and Solex, even if they had to see them disappear. With 7900 employees still working there, the deal was bound to go through. To this end, Jaeger was modernized at an accelerated pace (investments of 500 million francs per year) and would now be in the black, with the branch as a whole breaking even in 1985.

We can gloss endlessly on the pertinence of the initial agreement. Could Mr Lagardere have foreseen in 1980 Renault's rout, Peugeot's absence of interest in electronics (one might have guessed it at that time), and the difficulty of remotivating the personnel of the new subsidiaries? The answer is not clear, even with hindsight. We can then understand this man of action: it's hard and I'm going ahead. It was not his lack of caution, but rather the industry's own excess of caution which killed it.

While it lacked discernment in automobile equipment, Matra went right off the track in watch making. "This area will inescapably move to electronics," declared Matra's boss in 1980, after buying Jaz one year earlier. His estimate was correct, but it involved very specialized, mass-production electronics, the kind for which Matra was in no way prepared and which the Japanese do best.

This was a super-challenge to accept, and some government assistance to exploit. "A warning to the excellent acrobat, who for greater effect, leaps once too often." Having failed to heed his own advice, Mr Lagardere lost 50 million francs per year (100 million last year) with 1000 employees busy installing watch movements from the Seiko associate into cases which they manufactured. "If we did not have to bear 9 percent in financial costs where the competition has only 3 percent, we would be breaking even," candidly stated Mr Prieux, who is also in charge of Matra's watch making.

Unlike automobile electronics, in this case Matra would like to lose its majority, and is pushing Hattori Seiko in this direction. But the Japanese partner wants no part of it: he is satisfied with his 20 percent. Will it be necessary to force him to fulfill his European manufacturer duties?

Because he likes the consumer, Mr Lagardere was somewhat quick to believe that the feeling was mutual; the automobile, watch making, and microcomputers taught him harshly that it is possible to make good missiles, and even a good

personal computer, and still not have the brand name reputation of the former necessarily reflect on the latter. Such is the sad history of the Alice microcomputer, whose production was stopped in 1985 after 40,000 units were sold. One drop of profit in a sea of losses for this product whose performance was very fast but whose BASIC was incomplete, and which above all was poorly positioned on the beginner market, a market that had made Sinclair's fortune five years earlier. In 1984, the fad for BASIC was over. National education was still available, but Thomson was chosen instead, and Alice was dead.

The same type of difficulty arose with Alcyane, whose promoter, MCB, acquired in 1981, could have been the French Apple, if this possibility had existed. Also high-performance and oriented toward professional applications, Alcyane suffered first from poor distribution, and then from its incompatibility with the IBM PC, when that became a blemish. Alcyane was stopped, as well as Max, another professional microcomputer, IBM-compatible this time, but too expensive.

Under these conditions the poor results of Matra's computer branch are understandable: 110 million lost in 1984 and 100 million last year, with revenues of 280 million francs. That was too much for this vital sector. Refocusing on advanced technology microcomputers was started in 1984 through an agreement with Norsk Data. Maurice Remy, director of the communications branch then assumed chairmanship of Matra Datasysteme, the new name for MCB. Soon after, Charles Picasso arrived from Prime and implemented the reform.

Two areas of activity were opened at that point: scientific computers and terminals. The first hinged around the very sophisticated products of Norsk Data, assembled at Bois-d'Arcy since March 1986. An order of 200 million from CNES has already confirmed this good choice, and 170 employees are working on fabrication and joint development with the Norwegian company. "We are aiming for revenues of 160 million this year in this field, and 390 million for Datasysteme, of which 220 million for the PMU," says Mr Picasso.

The PMU? These are specialized terminals, very profitable for the customer and for Matra, which is producing 200 million of them per year. "We are studying an expansion of these terminals abroad, as well as industrial applications." This particular sector employs 180 people. But scientific terminals are primarily CAD work stations, and an agreement with Sun Microsystems "approved by Norsk Data" will give Matra very high performance products. "This gives us a lead of three to four years," estimates Mr Picasso, who also sees an opportunity to enter the American market, where $20 million of orders have already been received.

It is also the opportunity for Matra to introduce at Sun the 64-bit processor adapted for artificial intelligence and developed at Velizy. Lastly, the Eureka project for a vector computer--the cutting edge of this field's architecture--with Norsk Data, should make Datasysteme a major pillar of Matra's technology on the hottest sector of the intermediate computer market.

So much for the computer branch. Datavision, probably the best subsidiary of the group, was assigned to the automation branch for lack of another classification in 1979. But since Alain Nicolaidis, Datavision founder and present CEO, has shifted part of his activity from software to hardware, its assignment to the computer side seems more appropriate. Having gone from 140 million francs in 1984 to 230 million one year later, Datavision, which is earning money (about 5 million in 1985, 7 million in 1984), would flourish better in this branch, which it clearly overlaps. Especially since Datavision exports on the same markets in the United States (10 million francs in sales in 1985) and in Japan, where Datasysteme is not yet implanted.

Currently associated with Sormel (assembly) and MGCA (integrated circuit machines), Datavision is the only survivor of the its original branch. Manurhin, which constituted the branch, has disappeared, leaving the bitter memory of an industrial tragedy, and a 1 billion franc hole.

The prosperity of the old Mulhouse company was assured by weapons; in 1978, its machine-tools were still a symbol of quality. But military contracts simply became oriented toward complex systems and Manurhin was losing ground. When it was put up for sale, Matra saw an excellent opportunity to enter the market of modern production equipment, even if it meant updating the equipment and management of what still remained of a good enterprise. Moreover, it could be a good way to diversify Matra's weapons--limited until then to air systems--into ground equipment. Without extensive analysis of its accounts--without even being able to probe them, it is said--Matra acquired Manurhin; it is true that it was prodded by the government, which, anticipating difficulties, paid what it had to in order to dispose of it, under the excellent pretext of creating a computer-aided production hub in France.

In 1982, when a Matra man finally came to lead Manurhin, he discovered what had been so well concealed: the company was totally unworkable. A personnel of 5183 people, no more company funds, and 1 billion in debts for revenues of 2 billion francs! Massive injections of funds and layoffs were not enough. Unfortunately, the fine contract of the Famas rifle (the Clairon) slipped through its fingers in 1981 for primarily political reasons; on the other hand, Manurhin received a few orders for Apilas, a very competitive rocket launcher.

As first aid, Matra divided the activities to save the military sector integrated into the Matra parent company; the mechanical part would be cleaned up and sold--if possible. One attempt almost succeeded last autumn; but Laurent Fabius opposed "in extremis" the acquisition of Manurhin Automatic by the German-Bulgarian company Webo Roterwerk.

Caution With The Next Bargain

With its two companies Manurhin Defense and Manurhin Automatic, the former star of the French mechanical industry lost 358 million in 1983 and 270 million in 1984. We can expect that Mr Lagardere will be more suspicious of the next good-as-new bargain offered to him on a silver platter.

Fortunately, Sormel with 120 employees and 65 million francs in revenues, breaking even last year (but losing 20 million in 1984), conceals no bad surprises. From assembly, the company is moving into robotics with good chances of success. Matra is seeking an associate to share the development costs of this expensive specialty; Asea and a Japanese company might be candidates. And Matra CGA could become a profit center with its resin processing machines for integrated circuit fabrication; but its products are too specialized to be truly complementary with Matra's other activities, except for MHS.

With Robotronics sold and Manurhin Automatic on the block, what is left of the French computer-aided production hub? Datavision, which would be better off at Datasysteme, and Sormel; but that does not a hub make!

It is probably around integrated circuits, and around Matra-Harris Semiconducteur (MHS) which produces them, that the polemic on Matra's choice has been the most lively. And most inopportune as well: how could this enterprise, oriented toward those markets where only the most advanced components matter, avoid fabricating them, whatever the cost? If there is one activity which fits in the "to keep even if not profitable" category, that is the one.

Created in 1979 through one of the 51/49 agreements so dear to Matra, with Harris which had the best CMOS technology at the time, MHS settled in Nantes and immediately made some high sales claims: 700 million francs in 1985! Announced in 1980, this objective extensively contributed to the lack of credibility which plagued MHS afterwards. And what were the actual revenues last year? 440 million. Over such a time span, that is a small discrepancy to any one who knows the instability of this sector. But these sales have been very costly since 1980: 60 million lost in 1983, and 180 million the next year.

It is particularly these losses, presented as exceptional, and which a debt waiver erased at the right time, that raised the suspicions of analysts. When, drawn along like all the rest by the extraordinary year of 1984, MHS managed to break even, everyone thought that this was the least to be expected of it under the circumstances. But when one year later MHS sustained this result in a very depressed environment, no one considered it a feat. And yet it was a feat, due as much to the market slots the company had chosen--high performance circuits in small batches, as to the enormous efforts made to stabilize and perfect the level of its production lines.

In a field as changeable as that, it is not advisable to forecast a company's future. But taking our cue from Matra's leader, let's take that chance: MHS (800 employees) seems to be out of danger, at least as long as it keeps to its specialties, notably integrated circuits for telecommunications, developed by Cimatel, an MHS and Intel joint (50/50) research company for these circuits.

Fast memories issued from the agreement with Cypress are another aspect of this policy, which is ultimately that of the Matra group as a whole: become associated with the best to jointly develop products at the cutting edge of their specialties, with European marketing being provided by Matra.

Computers, components, telecommunications; the last member of tomorrow's threesome would have to be present when you harbor Matra's ambitions, and present it is. Also reorganized, the telecommunications branch had revenues of 1.3 billion francs in 1985 with 2700 employees, breaking even in fields that are after all dangerous, such as private telephones, where Siemens for instance, intends to become fully involved. All that was lacking was critical size.

Strong Adversaries For Matra

With the acquisition of CGCT's private telephone activity, Matra communication which last year integrated Peritel (93 million losses in 1983), may have reached that critical size. But mainly, this operation provides Matra with CGCT's Central Telecommunications Laboratory (LCT), which is very knowledgeable in digital and military radiotelephones. Moreover, CGCT's top automatic switches are a fitting complement to the branch's line of products. And to link the various terminals of office automation, there is even an optical fiber network supplied by LCT!

Equally reborn is the transportation branch, which was biting its nails with worry until 1985, and where hope has returned with the orders for the VAL automatic metro. This is another branch that had been losing money until now (100 million in 1984), and almost broke even in 1985 with a few millions in losses for revenues of 371 million francs. A surprise from the heavens? As usual, the expression discloses a misunderstanding of the problem.

It is actually the same step that has led Mr Lagardere to launch himself into special automobiles, robotics, and urban transportation. The automobile venture can hardly be termed a brilliant success; it will need years of strong profits for that. But who can say today that this is impossible? What remains true is that the total lack of synergy between this branch and the remaining ones should cause Matra to drop it sooner or later, for the sake of a homogeneity which is essential to the grand design of electronic communications.

When the decision to build the VAL was made in 1972, nothing except intuition really justified its development. Of all of Mr Lagardere's bets, this is certainly the most daring, and yet success seems on its way.

"We cannot win everywhere," says Mr Lagardere. But does one have to be everywhere? It should be noted that if he has lost a lot of money with this principle, he also stands to win a lot more, as long as his competitors run out of wind before him.

And that is not at all probable, because by dint of growth, Matra will meet imposing adversaries on arenas that have become too large for it: Philips, Siemens, General Electric, or Hitachi. To snatch the smallest portion of a market from these giants, Matra will have to fight a trench warfare.

Six Billions In Weapons And Space

Space and the military represent one half of Matra: 5.97 billion francs in 1985, 433 million in operating results. It is Matra SA, called "the parent," that has brought Matra as a whole a profit of 113 million, a result which in fact clearly illustrates the strong reduction in subsidiary losses. And yet, in 1984 Matra SA had achieved 732 million in operating results; that points out the drop sustained in one year, especially due to the military sector. Matra is first of all missiles: the 550 Magic for dog fighting, the 530, the ground-air Crotale, the anti-radar Armat, the anti-vessel Otomat, and the Mica for tomorrow's plane; the full line is covered with great success for this equipment, which has made Matra's fortune. And that does not include the Durandal anti-landing strip bomb, of which the United States has ordered 21,000 units, bringing $780 million to the French group.

But the uncertainties of this sector, which have led Mr Lagardere to select more stable markets, are manifested in lost contracts or rejected equipment. Last year for instance, the Swedes ultimately preferred American missiles to Matra's Magic. The Norwegians bought the Swedish ground-air system instead of the Mistral considered at first. With the fortunate exception of the Crotale, Matra does not seem to be too successful in the ground-air specialty. During the bargaining to replace Pluton with Hades, Matra's project was rejected in favor of Aerospatiale's missile. The French military made the same choice again with Aerospatiale's Aster, thus confirming that company as supplier for this type of equipment. This is a hard setback for Matra, especially since Aster lends itself to development into an anti-balistic missile through its superior performance; another refocusing in the offing.

On the other hand, the space sector--Matra SA's other segment--is doing well. It is true that the group has just lost the three Eutelsat satellites, but it has Spot, a great success in which Matra has invested 1.3 billion francs, plus 300 million for Spot 2, which is to be launched in 1987. Compared to the military (4.5 billion, 3500 employees), space is still a small activity of 1.5 billion and 1500 people, but one which has doubled in five years. In various cooperations or as prime contractor, 25 programs assure a good future for this branch. Moreover, Matra is responsible for the equipment box of the Ariane launcher, that is to say a good portion of the rocket's electronics. Ariane's success is thus Matra's as well.

Agreements With The Best

In order to gain some time, enter foreign markets, and especially share research and development costs, Matra often uses agreements with complementary partners. Not an easy task when your name is Matra; only the best are good enough! But the best frequently have a position and a self-image which make them rather inaccessible. Because thanks to its air-air missiles Matra was able to enter this exclusive club, it can now be proud of a string of allies which are or were considered worldwide leaders in their field; what is more, the agreements reached with them, most often create 50/50 joint subsidiaries.

In electronic components, the agreement with Harris, which holds 49 percent of MHS, is one such success. In 1980, the American company had the world's fastest CMOS by far; but it was not well known due to the weak penetration of this technology, despite years of marketing. Matra's merit was to nevertheless guess its potential; MHS's good results today derive from that.

Same approach with Intel, but in a narrow market slot. Cimatel, half-and-half joint subsidiary, is now producing its first complex circuits specialized in telecommunications, a sector in which the two companies have decided to invest separately, using these products.

SGS, the dynamic company led by Pasquale Pistorio, has also signed up with Matra. Last October, MHS updated its CMOS technology to top level by gaining participation in Cypress, current specialist in ultrafast and very high density static memories. Production of these circuits is beginning right now. For the two parties, the advantage is to have the other as second source.

The Norwegian Norsk Data, which sought to penetrate in France, needed an associate well established in the high technology environment of scientific computers. With Matra, which wanted to develop this computer area at the time, the agreement was easy; it is beginning to yield fruitful results.

Tandy's products, launched too late, were not as successful; but Tandy was also a good choice, like Sun Microsystems, the Californian which is entering the work-station market.

Most of these names were little known before their agreement with Matra, and it is certainly not the French company which has launched them since. But we can nevertheless praise its discernment or its intuition about the technologies of tomorrow.

Euromask: A Technology Too Far

When Paul Tigreat, researcher at Leti in Grenoble, left his warm cocoon to begin the Euromask adventure, he started with a combination of good ideas and of perceived needs. Spurred by the 1980 Electronic Components Plan, Mr Tigreat had perfected at Leti a device to accurately and rapidly position silicon slices for etching during integrated circuit fabrication processes.

Two original features gave a unique performance to this subassembly essential for wafer photorepeaters: positioning with a Jobin Yvon holographic network, and the use of a carbon-fiber moving table. Together with a Cerco specialized objective, it was the basis of a French machine competitive with the Thomson-Cameca equipment being designed at the time.

It was thus with the blessings of the government and Leti that Mr Tigreat created Euromask at Meylan in 1981. Its aim was to produce the Eurostep 2000, the most advanced stepper of the day. Like many excellent engineers, Mr Tigreat believed in success through technical performance. But orders were not coming in. The machine was not sufficiently perfected and manufacturers

prefer the security of well known names which guarantee rapid and effective after-sale service. Moreover, this type of equipment can be promoted at first only in one's own country, if only for the final adjustments. But who in France manufactured integrated circuits? The Americans, Motorola, National Semiconductors (Eurotechnique in 1980), or Texas Instruments had what they needed. Thomson? It already had Cameca. There remained Matra, which together with Harris had started to produce top of the line circuits.

Mr Lagardere liked Mr Tigreat's undertaking, his technical skill, as well as his courage. The matter was settled: Matra would build the French stepper ahead of Cameca, thanks to Euromask which was brought into the group.

There was no question of profits before several years. But the machine was perhaps too sophisticated, and its final adjustments dragged on, at a time when the semiconductor industry entered a recession which seemed destined to last. At the end of 1982, having to move on, Matra joined forces with GCA, world leader in semiconductor production equipment. Highly indignant, Mr Tigreat took his leave.

In a corner of the Malville plant, the Eurostep 2000, covered with dust (supreme insult for a machine accurate to less than 0.1 micron), is all that remains of the Euromask adventure.

Was this isolated attempt abandoned too soon? Anyone who knows the cost of a breakthrough into microlithography equipment, even for an American at home (witness GCA's present difficulties), and who sees Japan's advances in this sector, can feel that Matra was thus able to avoid a financial botomless pit.

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WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

FRENCH VENTURE CAPITAL LEGISLATION ANALYZED

Paris BIOFUTUR in French Apr 86 pp 43-44

[Article by Thierry Brocas, Offices of Gide-Loyrette-Nouel, 26 Cours Albert ler, 75008, Paris: "Venture Capital and French Legislation"]

[Text] In a previous BIOFUTUR article (No 14, June 1983), we examined venture-capitalism and doubted that this American phenomenon could be transplanted as such in France. Since then, a number of measures have been taken by the government to fiscally encourage the creation of high technology companies in our country. With regard to BioEurope, probably he the most recent of the so-called venture-capital companies in the biotechnology field in France, we thought it would be interesting to find out the opinions of the legal counsel that assisted in that company's formation. From our standpoint, the answer is in three parts:

Recent fiscal measures undoubtedly encourage financial investors, even if there is hope for even more in this respect;

What has already been done for entrepreneurs or researchers involved in high-tech companies is totally inadequate compared to what is available in the United States;

But beyond these fiscal incentives, we believe that a thorough analysis must be carried out on the adaptation of French business law to the creation of these enterprises, and we want to raise just one point in this respect: the difficulty of obtaining capital increases for companies whose value during formation is primarily intellectual (intangible assets), when this value has to be estimated and capital auditors have be called in.

A company such as BioEurope has certain particular characteristics:

A management which originated the idea on which the company is based, but which does not have the financial means to implement this idea and must therefore gather together a group of investors;

An activity oriented solely toward research and the exploitation of the results of this research.

These characteristics are currently more or less adequately considered by French law and fiscal practices.

French legislation has recently given some consideration to the particular needs of venture-capital investment in the research and development sector.

Incentive Measures...

The General Tax Code allows companies which invest in buildings used for certain research operations, an exceptional amortization in the first year, equal to 50 percent of the cost price (except for a deductible VAT), as long as the buildings meet a certain number of conditions.

Similarly, the companies have the option of converting scientific or technical, as well as software design operating expenses, into fixed assets or immediate deductions. They can amortize the acquired software over a 12-month period.

Lastly, article 244 quater-B of the General Tax Code establishes a tax credit equal to 25 percent of the research costs increase from year to year, up to a limit of 3 million francs per year.

...Poorly Adapted to Venture Capital

These incentive measures primarily concern already existing enterprises, and offer no specific encouragement to the creation of venture-capital companies oriented toward pure research, even though these companies could obviously make good use of such incentives.

A more direct incentive to the creation of such companies can be found in the provisions of fiscal law which foster the interest of investors in new companies.

First of all, the General Tax Code (article 30 quinquies A-II) allows industrial or commercial enterprises to amortize up to 50 percent of the stock and shares subscribed to the initial capital or to capital increases in companies or organizations that have received special approval from the Ministry of the Economy and Finances. Moreover, the sale of this stock or shares after three years, receives favorable treatment for value-added tax.

In the same way, an exceptional amortization of up to 50 percent is applicable to capital subscriptions in innovation financial companies whose objective is to facilitate the industrial implementation of technical research in France, as well as to promote and exploit inventions of products, processes, or techniques already or about to be patented, but which have not yet been exploited or for which entirely new applications are possible.

The Law of 9 July 1984 on the development of economic initiative has sought to increase these financial incentives in connection with the creation of venture-capital companies. The law has raised the possibility of amortizing

up to 75 percent, to the extent that the subscribed amount is allocated principally to financing operations aimed at installing programs for research and industrial implementation of new techniques or products, and associating innovation financial companies with enterprises and researchers as part of an agreement approved by the government.

Legislation, Entrepreneurs, and Researchers

The above concerns investors and the companies themselves. What about the advantages available to entrepreneurs and researchers involved in venture capital companies?

For them, French law also has a number of encouraging provisions.

A law dating back to 31 December 1970 makes it possible to establish stock option plans which can take the form of subscription options as well as as buying options (in the latter case to the extent to which the company stock is quoted on the stock exchange).

However, these options are limited by a number of conditions:

An employee can use them only if he does not own more than 10 percent of the capital stock (or a lower maximum established by the General Assembly);

The total number of options offered and not yet exercised cannot exceed various percentages (5 percent of the capital up to 10 million francs, 3 percent between 10 million and 50 million francs, and 1 percent above 50 million francs);

The value of the options offered to any one employee cannot exceed certain limits (either twice his annual salary, or ten times the ceiling used to determine the maximum amount of Social Security and family allocation contributions).

In principle, company representatives cannot benefit from these options, except when they have participated with employees in the creation of a company or in obtaining voting majority through acquisition.

Stock options benefit from financial incentives: the value-added corresponding to the difference between the real value of a share at the time the option is exercised, and the subscription or purchase price, is tax-exempted to the extent to which the acquired shares remain in a nominal form and are retained by the beneficiary for at least five years from the date the option is attributed, and in any case, for at least one year from the time the option is exercised.

A description of the major provisions in French law aimed at encouraging investments in research and at promoting the creation of venture-capital companies, can appear impressive.

Nonetheless, we must not forget that the success of advanced-technology venture-capital companies in other countries than France rests on the convergence of entrepreneurs, researchers, and investors in a legal and fiscal environment favorable to risk-taking and the rapid profits than can result from it.

In itself and despite the specific incentives which legislators have sought to introduce, the overall ponderousness of the French fiscal system is a significant obstacle, notably in motivating entrepreneurs and researchers.

Moreover, as in many other areas, the French system is characterized by government interventionism (notably in approving research companies).

It seems difficult in the present framework of French legislation, to motivate under good conditions, entrepreneurs and researchers who want to join investors in venture-capital companies, and who legitimately want to receive compensation for the risk they take along with the investors.

To the extent to which these researchers and entrepreneurs do not in principle have sufficient financial means to make the initial investments that would later allow them to derive all the profit from the success of their ideas and activities, it would be appropriate for the legislature to make it possible in one way or another to remunerate their investments in ideas and know-how as if these were genuine financial investments.

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WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

RESEARCH INSTITUTIONS, STRATEGIES IN FRANCE, FRG COMPARED

Paris LE MONDE in French 6 Aug 86 p 9

[Article by Michael Werner (Footnote 1) (Research director and president of the "French and Foreign Literature, Language, and Culture" section of the National Committee of CNRS): "The Three Pillars of German Research"]

[Text] CNRS is undergoing a bad period. A reform decree is under preparation. A German scholar and research director at CNRS compares the organization of research in France to that in West Germany.

The English science review NATURE ended an article on the recent developments in French university and scientific policy with a vivid metaphor: "...the French university system is yet again lifted up by the roots to see how the fragile plant is growing." (Footnote 2) (NATURE vol 321 p 714 (19 Jun 1986)). In fact, the scientific community in the large countries which are France's partners and competitors is stunned by the spectacle of current French research policy: the private bill on universities only 2 years after the last reform and the threat of paralyzing CNRS resulting from a decision by the Council of State concerning one method for election to the National Committee; certain groups are even demanding the complete abolition of CNRS.

How, then, do research institutions operate in the most advanced democracies? I will not use the American system for purposes of comparison, but rather the West German system, because its efficacy has often served as a type of reference.

Research in West Germany rests upon three pillars: the universities, the National Research Center (Deutsche Forshungsgemeinschaft, (DFG)), and the Max-Planck Institute.

The universities, which do not compete with the professional schools for prestige and infinitely superior financial resources, have the fundamental responsibility for basic research. Their strong tradition, almost 200 years old, goes back to the von Homboldt reform (1812), based on principles of teaching and research independence and cooperation; on the whole they have done a good job of handling the large number of students since the end of the 60s. Their vitality

was stimulated by the interregional competitive climate--the universities are responsible to the authority of the Länder, i.e., the regions.*

Independence

However, given the increasing complexity of science and the large budget amount at stake--approximately 65 billion francs as compared to 35 billion in France--such a system would not be viable without a regulating and coordinating organization. It was for this reason that the DFG was created. It is a semi-public body financed almost exclusively by the Federal Ministry of Research and by the Länder, which promotes and supports large scientific programs, organizes international cooperation, distributes stipends to young researchers, etc. The committees of the DFG, all elected by the university at large, constitute a research parliament, which brings together the most highly-qualified specialists in different disciplines. A large proportion of the DFG budget (approximately 3.6 billion francs) is used to finance progressive programs within universities.

Finally, the Max-Planck Institute, a private institution directed by a committee of approximately 40 scientists, with 90 percent of its support from the government, has set out to stimulate and implement basic research in particularly promising areas. Its origins go back to an initiative taken under Wilhelm II, just before World War I, for the purpose of optimizing research output in technical areas. Today it manages approximately 60 research institutes, the largest of which has 1000 researchers. The Max-Planck Institute employs a total of 4000 researchers (who have no teaching duties). The directors of the Institute and the research collaborators are government employees who have lifetime researcher posts. In addition, the Institute provides technical training for dedicated young researchers. Slightly more than one-half the Max-Planck budget, which amounts to some 3.3 billion francs, goes to the physics, chemistry, and technology section; 33 percent to biology and medical research, and 15 percent to social science and human science. The amount allotted to this last section is thus proportionally comparable to the amount granted at CNRS.

Finally, in contrast to what occurs in France, in Germany, there are many foundations financed by large corporations (Volkswagen, Bosch, Thyssen, etc.) which are directed by committees of scientific experts.

In general, this system is based on the principle of absolute independence with regard to supervisory policies, which are not involved in appointments within research organizations. Research management is the exclusive province of elected scientists. This institutional continuity favors the rapid adaptation of the scientific establishment to new developments in science.

By contrast with West Germany, French universities--except for the medical sector--are in a relatively weak position: the professional schools siphon

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*Translator's note: German states.

off a significant number of the best students; College de France, CNRS, the Museum,* the Institute,** and l'Ecole Pratique des Hautes Etudes can offer these students only a limited role when they are not associated with these institutions.

Research is a structure derived from progressive historical legacies. In contrast to West Germany, the French system was based on the establishment of professional schools and national institutes rather than on University reform. The scientific concerns of the French University barely predate 1870 by only a few years. This distribution of tasks is certainly not immutable; over the past few years, in cooperation with CNRS, the professional schools (the most prestigious ones answer to ministries other than the Ministry of National Education) are in the process of making changes which should not be interrupted. However, in any case, these developments are both slow and delicate.

Common Logic

The current system is not in such bad shape as some people might think. With regard to results, French research compares favorably to research in other countries. According to experts, its merit derives essentially from the central institution, the CNRS. In fact, CNRS manages not only its own laboratories, it also manages, with a network of cooperation agreements, all the institutions (universities, professional schools, etc.) which call upon it for help and want to undertake high-quality research. Far from constituting a separate block, it actually acts as a regulator and as a catalyst. The principle of permanent evaluation by the scientific community of which it is composed leads to profound research work which would be difficult for a contract system to provide. In addition, CNRS is a favored representative in international scientific cooperation. In cooperation with the research management of the Ministry of National Education, it has a scientific perspective which allows it to discover new research directions and to incorporate them on the institutional level. A great deal of work on making changes and on incentives in the management of regional areas and the industrial sector has been accomplished over the past few years. For example, CNRS is responsible for the scientific growth experienced by the Rhone-Alps region.

With regard to the current situation in France, these comparisons can be summarized by a few observations:

--In Germany as well as France, the organization of research is being integrated into a process with a long history—grafts should not be made onto fragile plants from which the roots have been removed under the pretext of helping them to grow. Any attempt to rapidly transplant foreign models would inevitably result in failure.

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*Translator's Note: Probably Museum of Natural History.

**Translator's Note: Probably the Institute of Scientific and Medical Research (INSERM).

There is, nevertheless, a common international logic to any research organization: There must first of all be a minimum of institutional continuity, not only for the implementation of scientific policy, but also for expansion of the scientific profession; then a process for evaluation and monitoring must be established and carried out by scientists; and finally, the research establishment must maintain a highly adaptable faculty, which is essential for succeeding in international competition, where a delay of several years may prove to be irreversible.

--In West Germany, where the university has a very strong research tradition, at least 2 institutions comparable to CNRS coexist. Dismantling CNRS would not improve the research potential of French universities; on the contrary, they have everything to lose.

The designation of scapegoats will not take the place of scientific policy. At the very least, we must wait for the new gardeners to show some respect for the crops they are responsible for....

13146/12859
CSO: 3698/643

WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

BRIEFS

FRENCH 1987 INDUSTRY BUDGETS REDUCED--The budget administered by Minister of Industry, Posts, Telecommunications and Tourism Alain Madelin will be reduced by 10 percent in 1987 from this year's total, with a comparable structure, according to the "ceiling letter" sent by Minister of Economy, Finance and Privatization Balladur. The credit allocation for his ministry will come to 25.4 billion francs (as compared to 28.3 billion for 1986), to which will be added the credit for the routine services and for research and the electronic line charged to Posts and Telecommunications. Capital allocations to the public enterprises will come to 6.5 billion for Renault, CdF-Chimie and the metallurgical enterprise (LE MONDE, 10 July) and 700 million for electronics (as compared to 2.2 billion francs in 1986). Industrial policy allocations (machine tools, paper pulp) will be reduced to 1.3 billion, as compared to 1.9 billion this year. The allocation for the coal sector will be maintained, but probably in current francs (Mr Mitterrand committed himself to maintaining volume). [Text] [Paris LE MONDE in French 30 Jul p 20] 5157

FRENCH 1987 NATIONALIZED FIRMS' BUDGET--The government has established a budget total of 6.5 billion francs for the capital allocations to national industrial enterprises in 1987. This sum will go to Sacilor, Usinor, Renault and CDF-Chimie. Since market developments may cause the needs of each enterprise to vary, the distribution of the allocation will be effected in the course of next year. The allocations planned for the National Space Studies Center (CNES) and the enterprises in the "electronic line" (Thomson, Bull) will remain the responsibility of Posts and Telecommunications. The amount thereof has not yet been established. [Text] [Paris LE MONDE in French 10 Jul 86 p 27] 5157

CSO:3698/626

STET TO TRANSFER TECHNOLOGY TO PRC

Turin CHRONACHE DEL GRUPPO STET in Italian Jan-Apr 1986 pp 48-50

[Text] In reply to an invitation from Deputy Post and Telecommunications Deputy Minister Song Zhiyan, a delegation from the STET Group, headed by STET President Michele Principe and General Manager Giuliano Graziosi, went to the People's Republic of China for a stay of 8 days, beginning on 14 March 1986.

Traveling with the delegation were, among others, Dr Cacciavillani, president of the Selenia-Elsag conglomerate, and Eng. Pistorio, general manager of SGS Microelettronica. reflecting the close ties between microelectronics and telecommunications.

During sessions at the Postal and Telecommunications Ministry, both sides voiced their pleasure at the friendly atmosphere of cooperation that prevailed in the areas of research and development, in telecommunications activities and in the industrial sector, and at the promising results achieved in these fields.

Contemplating the progress already achieved, bothparties expressed their eagerness to intensify and expand activities of common interest. Italy's ambassador to Peking, Raffaele Marras, addressing the opening session , confirmed the Italian government's abiding interest in enhancing cooperation between China and Italy in the postal and telecommunications fields.

To examine possible areas for further cooperation specialized meetings were called to deliberate the following matters: 1) supervising and monitoring telephone systems; 2) transferring know-how for production in China of Italtel-designed multipurpose keyboard telephones; 3)Fiber optics telecommunications systems and 4) postal automation systems.

Let's take a look now at what emerged from those meetings.

Telephone System Supervision and Monitoring

Both sides agreed on the advisability of a feasibility study for a national center to supervise and monitor the system, to be built in Peking for that purpose. Upon approval of the feasibility study by the Chinese Postal and Telecommunications Ministry, talks will begin as to what that Center should be doing, once in operation.

Necessary steps for completion of the project were discussed by both parties. The Chinese Postal and Telecommunications Ministry assigned top priority to this project, and the parties have promised to do their best to get the Italian government to provide the financial support needed to complete the project.

Transfering know-how to China to build Italtel-designed multipurpose keyboard telephones.

The China National Postal and Telecommunications Industry Corporation (PTIC) plant in Tianjin has asked Italtel for a proposal to transfer such know-how and for a licence to produce multipurpose keyboard telephones. Ital has made a preliminary presentation of the telephone apparatus and has delivered marketing documentation with a sample proposal on transfering know-how relating to aforesaid apparatus. PTIC will inform Italtel if the kind of equipment presented meets the stipulated requirements or not. Should the answer be a yes, the Italian company will send a technical delegation to the Tianjin plant to discuss details and gather data for drafting a proposal in line with the client's needs.

Fiber Optics Telecommunication .

In view of the encouraging results of scientific cooperation in the field of fiber optics, the parties have expressed willingness to explore the possibilities of cooperation on an industrial footing in that area as well.

Postal Automation Systems

There was a consensus as to further expansion of cooperation in this sector. In the course of the meeting, the Chinese delegation proffered data relating to progress with the project and voiced its view that the Italian proposal was feasible and that it met the technical requirements stipulated. It was agreed that the parties would do their best to obtain the Italian government's financial backing to complete the project. A warm invitation was extended to the Chinese authorities to visit ELSAG and the Italian automated Postal Centers already in operation.

At the conclusion of the series of meetings, both delegations voiced their satisfaction with the outcome of their discussions amd and reaffirmed their eagerness to enhance cooperation as part of the friendly relations between the two countries. Further, the

STET Group expressed its gratitude for the warm and friendly hospitality it had enjoyed during its stay in Peking from the Chinese Postal and Telecommunications Ministry.

The perfect windup to the Peking talks came with the participation by STET divisions in the Elecom '86 Show in Shanghai (20-26 March).

The Chinese authorities expressed keen interest in an admiration for the STET Group's products, especially for the high level of technology they embodied. Equally enthusiastic was the opinion voiced by the Hon Bogi, undersecretary for Postal and Telecommunications, who had come to Shanghai for "Italy Day" (24 Match). Accompanying Undersecretary Bogi were Italy's Ambassador Marras and top executives from the STET Group.

[Boxed Material]

Beginning in 1977, when the Chinese Postal and Telecommunications Minister of the day, Chung Fu-Siang paid an official visit to Italy, relations between the Chinese PTT Administration and STET have grown steadily and constructively, opening the door to entry for Group companies into major projects involving expansion of telecommunications and postal services.

Significant phases in the consolidation of those relations were:
1978: Senator Vittorio Colombo's mission to China with a delegation of PT Ministry staffers and representatives of the Italian telecommunications industry;

1982: A visit to Italy by a delegation from the Chinese PT Ministry, Department of Science and Technology, headed by Lian Jian, head of the Department;

1984: A visit to Italy by the Chinese Minister for Astronautics, Zhang Yun;

1985: A visit to Italy from the Chinese Deputy PT Minister, Song Zhiyuan;

and the final phase came with the arrival of a STET delegation in China, where it stayed from 14 to 22 March.

The Trade and Industry shows in Shanghai and Peking (next October) will be that many steps upward on the way to promising expansion of the Italian presence in the field of telecommunications and electronics in China.

6182

CSO:3698/638

WEST EUROPE/TECHNOLOGY TRANSFER

FIAT INTERESTED IN PRC MARKET

Turin ILLUSTRATOFIAT in Italian Jul-Aug 86 p 3

[Text] Hu Yaobang, General Secretary of the Chinese Communist Party's Central Committee toured the FIAT plant in Turin on 23 June of this year. With him were Deputy Prime Minister Li Peng and a delegation of ranking officials in the Chinese government.

Prior to his tour of the automated automobile production plants at the Mirafiori facility, FIAT Automotive Division general manager Vittorio Ghidella, presented Hu Yaobang with the keys to a FIAT Croma and a Panda.

Following that,the Chinese delegation was given a reception by FIAT President Giovanni Agnelli, General Manager Cesare Romiti, and other members of the corporate summit.

As the final stop on his official tour of Europe, Hu Yaobang picked Turin. That was a fairly significant choice, when you remember that Turin was the only non-capital city the Chinese General Secretary visited (Venice, thanks to its history and its artistic glories, was a special case).

The Turin meeting was certainly a high point in the history of relations between the People's Republic of China and FIAT, relations that have continued without interruption, marked by mutual esteem and satisfaction, for more than 20 years.

Proof that the PRC considers the FIAT Group one of its key partners in its technical and industrial development plans was forthcoming at every point in the meeting.

The guests (some 80 or more high officials and journalists)arrived early in the morning at Caselle airport. On hand to welcome them was FIAT President Giovanni Agnelli. After an exchange of greetings, they boarded a long cortege of vehicles which, preceded and escorted by the police, brought them to Mirafiori.

The Chinese delegation was welcomed by Vittorio Ghidella, general manager of FIAT's automotive division. In the enormous reception hall of the main office building, amid the TV lights and photograpers' (many Chinese)flashbulbs, came presentation of the keys to

the two vehicles given him. It was the Panda that evoked the most excitement among the guests, probably because the name was so familiar to all of them, thanks to the yet to be forgotten success that vehicle had chalked up in the "Marco Polo Venice-to-Peking Expedition last year and, maybe, because they see in that compact little car a possible solution to the demands for motorization of their enormous country. Hu Yubang reciprocated with the gift of a copy of a famous 16th-century porcelain vase.

At Mirafiori

The guests then boarded several special buses for a tour of the biggest and most advanced automotive plant in Europe: a kind of "total immersion" in the most advanced reaches of technology. A lot of interest and curiosity centered on the LAM which, using a robot-carrier driven by signals from the electronic "tracks" set into the pavement—is still one of the most innovative divisions in the world of automotive engine production. Equal fascination was noted at the automated and robotized assemblylines, and those for painting and assembling the newest vehicles—all unqualified successes—turned out by the FIAT group: from the "Uno" to the "Croma," from the "Y-10" to the "Thema."

Standing next to the test track, the delegation watched a parade of the entire range of FIAT and Lancia models (especially for the occasion, the review included the first FIAT car ever built: its $3\frac{1}{2}$-horsepower 1899 buggy). Arrayed around it in a semicircle were FIATALLIS earth movers (the rubber-tiredFR 10B and the tank-tread FD 14 bulldozer), recent FIAT models (60-90, 80-90, 100-90, 109-90 180-90, and 45-66, all in the 4-wheel-drive version), the off-road IVECO 40.10 WM (which had also taken part with the Panda in the Venice-to-Peking rally), one vehicle from the Daily line which had been "sliced up" to reveal engine operation and frame design and a set of industrial vehicles and two Iveco tour-buses, one of them the Orlandi "Ooker."

After all that, the guests had a chance for a first-hand look of some of the products of the group's divisions, for which FIAT has already signed agreements with Chinese agencies, and to pinpoint other potential areas of collaboration, including some in areas that, for the time being, could be presented only indirectly, such as machine tools, components, or civil engineering equipment.

For that matter, the Chinese have always paid particular attention to FIAT, thanks primarily for their more than 10 years of cordial relations that have thrived and expanded through exchanges of technical missions and visits by Chinese political people; FIAT has also maintained a continuing presence in China.

One need only cite the two major contracts signed last year, involving a total outlay of $250 million in financing by the Italian government.

On 27 March 1985 anothed accord was reached in Nanjing between Iveco and Nanjing Motor Corporation, under which the Chinese agency undertakes gradually to restructure 16 of its plants over a period of years, to build light trucks from the lines marketed in Europe as "Daily" and "Grinta (with plans to hit a rate of 6,000 units per year), as well as diesel engines (estimated output of 100,000 or so per year, in view of other applications.

Then on 9 June 1985 came the deal with FIAT Tractors which calls for annual production from plants in Shanghai and Luoyang of 20,000 farm tractors with ratings of 10 and 100 horsepower. In addition, the FIAT Group's collaboration with China has been expanding into the other sectors as well, including telecommunications (with input from Telettra: providing plants and technologies in several Chinese provinces), agricultural development and training personnel, in addition to agreements on compensation and counter-trading reached with Commissint, the group's trading division.

Collaboration

Chances of deals with other FIAT divisions looked fairly good during the meeting with Hu Uaobang and the top Chinese spokesmen went on to meet at the Marconi track, with FIAT President Giovanni Agnelli, general manager Cesare Romiti, and the FIAT summit.

In welcoming remarks, the FIAT president recalled that "in the long line of relations we have always moved forward together in a great spirit of collaboration and friendship on both sides. For our part, we have always striven to make our contribution to the Chinese people's decision to strike out on the road to industrialization and economic development. And we have always tried to understand and abide by the the rules of the country in which we work." Further, Giovanni Agnelli said, "we devote the utmost attention to the goals of your 8th 5-year plan to develop motorization for the masses. We truly believe that the automotive industry is a vital driving component of economic growth." On that score, FIAT "has a heritage of industrial knowledge and experience that we intend to continue to make available to your country in even broader measure and in whatever forms may be deemed most appropriate."

We should not forget that FIAT is known in China primarily as a company that makes automobiles: the Chinese authorities see in it vast and widely varied stores of experience that have been ripening and growing since the Twenties, insofar as concerns mass production of vehicles for the masses: first came the "Topolino," then the "600," all the way to the "126" and the "Panda" and every one of them was a"flower in our buttonholes"for all our products. The Chinese also know that FIAT is very good at technology transfers, again, backed by such disparate in-depth experience, such as that at the Soviet Union's Togliatti, or that in Poland, with Pol-Mot. The FIAT

fleet is not yet very significant in numbers (recent models number little better than 1,000), but it is symbolic at the image-making level: the "Argenta" and the "Regata" earmarked for government leaders.

FIAT, thus, is and will continue to be a privileged interlocutor for the Chinese government, as well as to the various sectors of industry, for private transport vehicles. It was no accident that Hu Yaobang, in thanking Giovanni Agnelli for his hospitality, made a special point when he said that "Chinese industry pays very close attention tothe FIAT Group, a group whose dimensions are global. Some projects have already been completed, others are currently under consideration. That is why our tour of Europe, which benag in London, comes to a close in the automobile canital," and thereupon proposed a toast "To the success of the House of Turin."

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WEST EUROPE/TECHNOLOGY TRANSFER

MONTEDISON TO SIGN $150 MILLION ACCORD WITH HUNGARY

Milan TECHNOSINTESI MESE in Italian Jul 86 pp 7,8

[Text] There are real possibilities for improvement in Italo-Hungarian economic and trade relations, especially through resort to joint ventures and the leasing system: these indications came out of a meeting in Rome between a Hungarian delegation headed by Ferenc Havasi, secretary of the central committee of the Hungarian Socialist Workers Party (POSU) and Confindustria President Luigi Lucchini. During that meeting, Confindustria reports, spokesmen for the companies most keenly interested in the Magyar market, including Montedison, told Havasi about plans for cooperation projects linked with development programs to be undertaken jointly with Hungary.

Just recently the Hungarian chemical agency, Chemolimpex and Montedison signed a 5-year marketing agreement calling for reciprocal shipments of chemical products over the 1986-1990 timespan, linked to the new Magyar development program. The contract will be worth $150 million (about 270 billion lire). The supply program includes, on Montedison's part, sale of various chemical products and plastic materials and purchase of intermediaries with high energy content. The contract specifications were signed in Budapest by Montedison general manager Giorgio Porta, and by Chemolimpex general manager Dobrovits.

The new trade agreement will be still more fuel for the already intense overall trade between the People's Republic of Hungary and the Italian industrial conglomerate that, for 1985, would top 60 billion lire. In addition to the products already cited, Montedison now sells Hungary pharmaceuticals, special fibers and rubbers, subject, however, to a number of other 5-year accords whose renewal is under discussion currently with Hungary's Medimpex, Hungarotex, and Taurus agencies, which deal with the three sectors cited. In the area of plant engineering, furthermore, Tecnimont, a Montedison engineering subsidiary, is engaged in a series of talks with its Magyar counterpart having to do with sales of chemical plants.

In Budapest, Porto held talks with a number of Hungarian leaders. Among others, he met with Foreign Trade Secretary Török and his deputy, Gombocz, Deputy Minister for Industry Kortvelyes, and the president of the Foreign Trade Bank, Demcsak, with whom he talked about prospects for increased bilateral collaboration.

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PRODUCTS, PROBLEMS OF BULGARIAN 'ELEKTRONIKA' PLANT

Sofia VECHERNI NOVINI In Bulgarian 10 Jul 86 pp 1,2

[Article by Mariya Budinova: "Along the Steep Path of Product Introduction"]

[Text] The manufacturing program is being successfully carried out at the Elektronika plant. Minicomputers and microcomputers for automation of the economy are in production. Problems are being encountered in training and procurement of the necessary personnel, quality improvement, and assurance of timely delivery under the production cooperation arrangement.

The Elektronika plant in Sofia is usually associated with the development of computers, which represent an integral part of scientific and technical progress. This plant continues to specialize in the production of minicomputer and microcomputer systems, which will pave the way for a strategic breakthrough in integrated automation of the Bulgarian economy. Good results have been achieved during the first six months. The annual production program has been completed to the extent of nearly 52 percent, and the accomplishments from the viewpoint of quality characteristics far exceed this figure. The economic effect projected for the six-month period by the scientific and technical progress plan has been achieved. These facts indicate the level of activity of the workers and specialists of Elektronika and the engineers of the Central Institute for Computer Equipment and Technologies, inasmuch as upgrading of production is accomplished precisely in the intense process of creative cooperation, through concentration of experience, know-how, and ideas.

The staff of the plant has basically three problems to solve in 1986. An updated version of the well-known general-purpose minicomputer system, the Izot-1016 S. M. 1, which is used for automatic data processing in various sectors of socioeconomic life, is currently being introduced. This system is already in use at the Elektronika for automated production management. And even while taking its first steps, so to speak, it is contributing to improvement in the organization of work. The Izot-1016 S. M. 1 can also be applied to automate planning work when used in conjunction with other technical facilities. The updated version is an entirely new structural development. It is produced by a new technology, is of modern design and more compact, and has a much larger external memory. Consequently, it can process a much larger volume of data. Two more new products, much more complex and of far greater significance to the economy, will determine the

production strategy of the plant during the 9th 5-Year Plan. And, although the scientific and technical progress plan is being fulfilled, there are some "hidden reefs" ahead.

As a final assembly plant, the Elektronika maintains relations with at least 50 Bulgarian enterprises. Coordination between individual links in the chain is incomplete. There is still no absolute connection between the scientific and technical progress plan and the production programs of the subcontractor plants. This connection should be secured by the planning and production elements of the Izot Economic Trust.

The daily work routine at the Elektronika is disrupted with considerable frequency by irregular deliveries. If a single plant is late in making deliveries, the operation of machines costing hundreds of thousands of leva is held up because of the lack of a single element costing, say, 1,000 leva.

The Elektronika staff is also encountering difficulties with the quality of articles supplied under the cooperation system. Even initial inspection at the Elektronika plant screens out some substandard video terminals shipped by the Storage Device Plant in Veliko Turnovo, along with the substandard disk drives and printers delivered by the United Typewriter and Office Systems Plant in Plovdiv.

Rebuilding and modernization of the plant is proceeding at a slow pace. Many problems are arising in technical re-equipment, including delivery of modern equipment.

Provision of documentation on new articles by specialists at the Central Institute for Computer Equipment and Technology is somewhat behind schedule, but this does not mean that the plant staff sit by passively, with their hands folded, so to speak.

"Our specialists," we are told by deputy director for technical matters engineer Asen Kaymakchiev, "participate actively in development and express their opinions on design, specifically, on the unified assemblies and parts which can be used. The time factor (the documentation was supposed to have been delivered by the end of June) naturally has had its effect on the incomplete treatment of articles. We have been forced to accept items which are not completely finished. As an example, the testing of printing plates is vitally important to us. Special tests are run for this purpose on specific technological machinery and equipment, but there is a long delay in forwarding the results of these tests to us."

"In some cases there actually is a delay," asserts engineer Vitko Elenkov, head of the minicomputer systems department at the Central Institute for Computer Equipment and Technology, "The reason is the severe shortage of designers. And in my opinion there are two factors contributing to this unfortunate situation. In the area of training, the needs for such personnel in electronics was estimated some time ago. And yet, very few engineers in this field are graduated from the Lenin Higher Institute of Mechanical and Electrical Engineering and from other institutions of higher education. In addition, we are witnessing a certain personnel drain from organizations such as the Central Institute for Computer Equipment and Technology because it is literally on the leading edge of scientific and

technical progress. Products for all the plants of the Izot Economic Trust system are developed and introduced into production here, and this necessitates extremely intensive work. Overtime work is often required. In addition, there are organizations which offer the same or higher pay for a lighter work load."

The negative effect of this problem is also felt by the Elektronika plant. For years now jobs have been open for engineers in the technical division and there has been an acute shortage of designers and programmers. Every year, and for every five-year period, requisitions are submitted for the required engineers, mathematicians, and programmers, but barely 20 percent of this demand is met. The plant staff has an idea of how to attract and keep engineer personnel, for example, by increasing the material incentives, along with resolution of certain social questions. The Sofia people's council must speed up the process of allocating land for construction of a housing unit for the plant and grounds for building a sports complex, and the Izot Economic Trust must secure apartments each year for the most critically needed laborers and specialists.

Of course, the problems exist and will continue to exist. In the process of their progressive solution, greater effort should be made to find additional reserves in discipline in order to improve the organization of labor. Hence the fundamental task facing the plant staff up to the end of this year and in 1987 is to double the output capacity and sharply increase efficiency. And the sole criterion by which the work of each person is rated today is the contribution made by the individual to intensification of production, under the more rigid requirements set for technical sophistication, quality, and competitiveness of products.

[Caption:] The Elektronika plant is introducing a modernized version of the mini-universal system, which is being applied in various fields of the national economy for automated processing of various data.

6115
CSO: 2202/26

EAST EUROPE/MICROELECTRONICS

BULGARIAN COMMENTARY ON CEMA MICROELECTRONICS COOPERATION

Sofia NARODNA ARMIYA in Bulgarian 15 Jul 86 p 4

[Article by Lybomir Parushev: "CEMA: Equitable and Mutually Advantageous Cooperation--Electronics, Leading Edge of Scientific and Technical Progress"]

[Text] Electronics is the most vigorously growing sector of the Czechoslovak economy. In 1985, electronic component production increased 19.8 percent over 1984 and manufacture of data processing equipment 26.5 percent. Integrated circuits were produced representing a value of 2.8 billion korunas (an increase of 32.4 percent), along with 1,460 computers (an increase of 35.2 percent). The development of microelectronics is especially dynamic. Conditions have been created for production of microprocessors, including auxiliary circuits of the 8000 family, RAM (random access memory), ROM (read only memory), and EPROM (erasable programmable read only memory). The production has begun of minidisk drives, integrated circuits by the CMOS (complementary metal oxide semi-conductor) technology, and single-chip microcomputers.

The element resources created and the production of computers of the SM series (the small-computer system of the CEMA member countries) have increased the possibilities of applying electronic devices in robot building and other sectors of the national economy of Czechoslovakia. The SM 50/40 and SM 50/50 microcomputers, based on a progressive hierarchical modular concept, are used in control of integrated robots and manipulators. The SM4-20 and SM 52/11 minicomputers are the basis of problem-oriented complexes in health care, agriculture, and power engineering, and also in automated control systems (ACS) for production processes. "Medium-sized" computers of the ES (unified computer system of the CEMA member countries) have also been introduced: the ES 1024, which represents a good basis for organization of ACS in the non-production sphere, the ES 1025, and the ES 1026. The ES 1027, with an improved operating module and operating memory, has been in production since 1985. This computer performs 400,000 operations per second, a fourfold to fivefold increase over the speed of the ES 1026. The development of the 8080 microprocessor and the 8048 microcomputer has provided the impetus for production of Czechoslovak personal computers.

Dot matrix printers, daisywheel printers, electrostatic non-impact (thermal) printers, and alphanumeric plus graphic display printers have been introduced in the area of peripherals.

Color television receivers with diagonal screen measurements of 67, 56, 42, and 30 centimeters are currently in production in Czechoslovakia. The KM 340 minicassette recorder (Walkman) was recently released on the domestic market. The first videocassette recorders have made their appearance. The selection of these recorders will be enlarged in 1986 by the addition of new models developed in cooperation with Soviet and Netherlands partners.

According to the documents adopted at the 17th CPCZ Congress, the share of electronics in machinebuilding output is to increase from 17 percent during the last 5-year plan to 22-25 percent by 1990. The goal of an average annual growth of 14-16 percent has been set for this sector. The production of semiconductor and microelectronic elements, computers, and automated elements will increase 80 to 200 percent. The investment program for the new 5-year plan calls above all for development of stocks of components, special-purpose machines, robots, and manipulators. It is estimated that an annual volume of 2.8 million korunas will be reached by 1990 in the production of technological and diagnostic systems. This volume will meet all the production needs of the national economy and will provide the output for 500 million korunas of exports annually to the CEMA member countries and for 100 million korunas of exports to non-socialist countries.

The most important requirement for accelerated development of Czechoslovak electronics is intensified participation by this sector in socialist international division of labor.

Scientific and technical cooperation with the USSR has resulted in development of equipment for electronic lithography, complete equipment for manufacture of very large scale integration (VLSI) circuits, equipment for surface inspection of solid materials, a new videocassette recorder model, and a portable color television set. The following projects will be carried out during the current 5-year plan: a project for VLSI circuits based on a 32-bit minicomputer, integrated circuits for pacemakers, television transmitters, broadcasting studio equipment, and optoelectronic devices.

Bulgarian-Czechoslovak cooperation in the area of electronics is proceeding very smoothly. Bulgaria supplies Czechoslovakia with computer peripherals, industrial engineering equipment, etc. Bulgaria is Czechoslovakia's basic supplier of fast peripherals. The Bulgarian contribution to stocks of Czechoslovak elements (active and passive electronic elements) in 1985 was double that of 1983, reaching 18.8 million rubles. The large-scale program for application of electronic equipment in the Czechoslovak national economy is creating the preconditions for increase in Bulgarian exports of electronic products. Bulgaria has the capability of specializing in the production of MOS (metal oxide semiconductor) integrated circuits, transistors, capacitors, silicon chips, etc. The Czechoslovak partners are even now showing interest in the new Bulgarian group coding storage devices.

Czechoslovakia is the first CEMA member country in which a 32-bit microcomputer has been developed and is to be manufactured. It is the SM 52/12, which will provide the possibility of developing high-capacity interactive (conversational) systems for automated planning and design (CAD/CAM [computer-assisted design/computer-assisted manufacture] and CIM [computer-integrated manufacture] systems). The microcomputer will be equipped with Bulgarian peripherals; this creates considerable potential for specialization and cooperation with Czechoslovak manufacturers.

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